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West Fork of Swift Creek Timber Sale Project

Draft Environmental Impact Statement

Resource Appendices

October 2004

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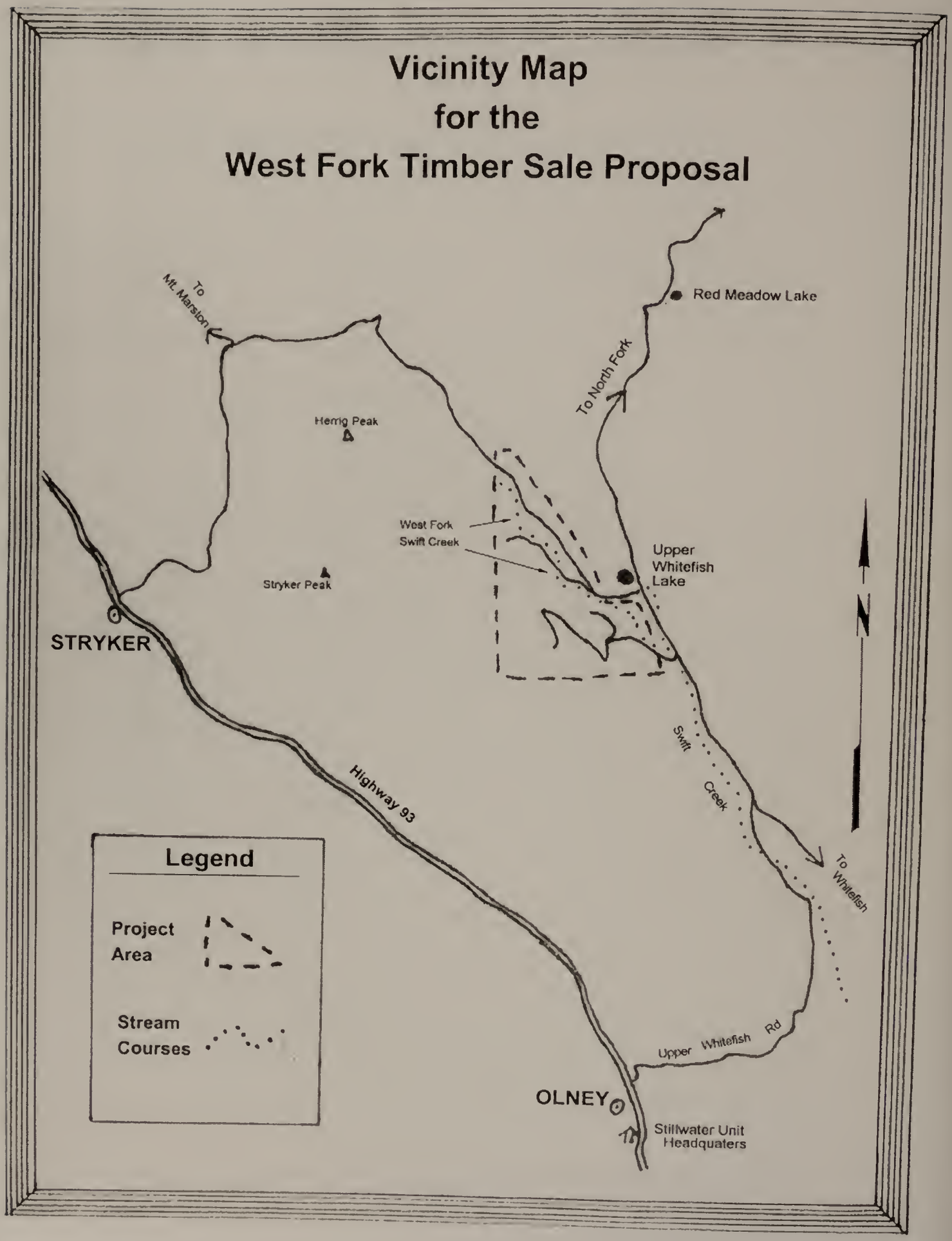


APPENDIX RESOURCES

TABLE OF CONTENTS

Appendix A - Stipulations and Specifications
- Watershed and Fisheries A-1
- Wildlife A-2
- Roads A-3
- Aesthetics A-3
- Air Quality A-3
- Soils A-4
- Noxious Weed Management A-5
- Archaeology A-5

Appendix B - Vegetation Analysis
- Introduction B-1
- Analysis Method B-1
- Analysis Area B-2
- Covertype B-2
- Age-Class Distribution B-4
- Old Growth B-4
- Stand Development B-6
- Alternative Effects B-9

Appendix C - Watershed and Hydrology Analysis
- Introduction C-1
- Analysis Methods C-1
- Analysis Area C-2
- Existing Conditions C-2
- Alternative Effects C-5

Appendix D - Soils Analysis
- Introduction D-1
- Analysis Methods D-1
- Analysis Area D-1
- Existing Condition D-1
- Alternative Effects D-1

Appendix E - Fisheries Analysis
- Issue E-1
- Introduction E-1
- Species E-2
- Analysis Methods and Subissues E-3
- Summary of Alternatives ..... E—6
- Existing Conditions E-6
- Alternative Effects E-27

Appendix F - Wildlife Analysis
- Introduction F-1
- Methods F-1
- Coarse-Filter Assessment F-1
- Fine Filter Assessment F-10
  - Threatened and Endangered Species F-10
  - Sensitive Species F-25
  - Big Game Species F-30

Appendix G - Economic Analysis
- Introduction G-1
- Existing Conditions G-1
- Alternative Effects G-2

APPENDIX A
STIPULATIONS AND SPECIFICATIONS

Stipulations and specifications for the action alternatives were identified or designed to prevent or reduce potential effects to resources considered in this analysis. In part, stipulations and specifications are a direct result of issue identification and resource concerns. This section is organized by resource.

Stipulations and specifications that apply to operations required by and occurring during the contract period would be contained within the timber sale contract; as such, they are binding and enforceable. Stipulations and specifications relating to activities that may occur during or after the contract period (hazard reduction, site preparation, planting) would be enforced by project administrators.

The following stipulations and specifications are incorporated to mitigate effects on resources involved with action alternatives considered in this proposal.

WATERSHED AND FISHERIES

- Planned erosion-control measures and BMPs include:
  - installing grade breaks on roads,
  - installing water-diverting mechanisms on roads,
  - installing slash-filter windrows, and
  - grass seeding.

  Details for these control measures would be included in *APPENDIX B* of the *TIMBER SALE AGREEMENT*.
- SMZs and Riparian Management Zones (RMZs) would be defined along those streams that are within or adjacent to timber-harvesting areas. Harvesting operations would be a minimum of 100 feet from the West Fork and Stryker Creek. This would be done to protect areas adjacent to streams and maintain water quality.
- Culvert sizing for all road projects would be as recommended by the DNRC hydrologist for a 50-year flood period.
- Stream crossings, where culvert or bridge removals and installations are planned, would have the following requirements, as needed, to meet the requirements of water-quality permits and BMPs and to protect water quality:
  - Slash-filter windrows would be constructed on the base of the fill slopes.
  - Silt fences would be installed along the streambanks prior to and following excavation at crossing sites.
  - Filter-fabric fences would be in place downstream prior to and during culvert installation.
  - Bridge work within the stream area on the West Fork stream crossing would be limited to the period of July 15 through August 20 in order to avoid the bull trout spawning period.
- Water-quality monitoring would continue in the Swift Creek and Fitzsimmons drainages to assess and track water quality and resource values associated with water quality. In addition, the monitoring would provide data for water-quality studies being conducted in the Flathead Basin.
- Brush would be removed from existing road prisms to allow effective maintenance. Improved road maintenance would reduce sediment delivery.

- The contractor would be responsible for the immediate cleanup of any spills (fuel, oil, dirt, etc.) that may affect water quality.
- Leaking equipment would not be permitted to operate in stream-crossing construction sites.
- Included in the project proposal are the following pertinent recommendations of the Flathead Basin Forest Practices, Water Quality, Fisheries Cooperative Program Final Report (June 1991).
- The following numbers correspond to the numbering of recommendation items contained within the aforementioned document, included in pages 154 through 162 of the final report:

1. BMPs are incorporated into the project design and operations of the proposed project.
2. Riparian indicators would be considered in the harvest unit layout.
3. Management standards of the SMZ Law (*75-5-301 MCA*) are used in conjunction with the recommendations of the study.
4. The BMP audit process will continue. This sale would likely be reviewed in an internal audit and may be picked at random as a State-wide audit site.
7. SMZs will be evaluated as a part of the audit process.
11. Swift Creek monitoring is part of the Flathead Basin monitoring effort.
12. Watershed-level planning and analysis is complete. Logging plans of Plum Creek Timber Company, USFS, and Stoltze Land and Lumber Company, as reported to the Cumulative Watershed Effects Cooperative, are used.
14. DNRC is cooperating with the DFWP on a further study of the fish habitat and population for Swift Creek and its tributaries.
15. DNRC would use the best methods available for logging and road building for this proposal.
16A. Existing roads are fully utilized for this proposal.
17. DNRC requested inventory information from DFWP. DNRC's mitigation plan for roads fits all recommendations for "impaired streams". Using "worst-case scenario" criteria provides for conservative operations in this proposal.
18. Provisions in the Timber Sale Agreement address BMPs that are rigidly enforced.
20. Planning for long-term monitoring of Swift Creek is in place.
29-34. DNRC has cooperated with DFWP to continue fisheries work. DNRC will continue to monitor fisheries in the future as funding allows.

WILDLIFE

GRIZZLY BEARS

The following items are incorporated into this proposal:

- The grass seeding plans to revegetate roads include a combination of seed mixtures that have different palatability in relation to grizzly bears. The less palatable species are planned for areas where bear use is to be discouraged to minimize the potential for bear/human conflicts.
- No logging camps would be allowed in the sale area.
- Garbage hauling would be required daily.
- The Forest Officer would, if necessary, immediately suspend any

or all activities directly related to the proposed action to prevent imminent confrontation or conflict between grizzly bears and humans or other threatened or endangered species and humans.

- Vigorous patches of Vaccinium sp. (huckleberry) would be avoided during scarification when possible.
- Contractors would be prohibited from carrying firearms while working under contract.
- All gates would be closed after each entry during the general big game hunting season.
- Road management would vary by alternative and includes proposals given in *CHAPTER II - ALTERNATIVES*.
- A vegetative screen would be retained along open roads.

WOLVES

A contract provision would be included to protect any wolf den site or rendezvous site within the gross sale area that may be discovered during implementation of this proposal.

CANADA LYNX

During site preparation, available cull logs would be piled to provide future habitat.

SNAG RETENTION

- Wildlife trees of high quality, such as large broken-topped western larch, would be designated for retention and given special consideration during yarding operations to prevent loss.
- Snag retention and recruitment: All cull snags that are safe to operate near and a minimum of 1 to 2 of the larger trees per acre, preferably greater than 21 inches dbh, would be retained. The number of trees and snags larger than 21 inches dbh is dependent on habitat group.

BALD EAGLE

- Timing restrictions would be implemented on the Whitefish Saddle Road; log hauling is restricted to August 15 through February 1.
- Timing restrictions would be implemented for logging operations in Harvest Area II-A with logging restricted to the period between August 15 through February 1.

ROADS

- Road reconstruction activities and road use associated with road construction activities would be relayed to the general public.
- BMPs would be incorporated in all planned road construction.

AESTHETICS

- Damaged residual vegetation would be slashed.
- Landings would be limited in size and number; locations would be away from main roads when possible.
- Disturbed sites along road rights-of-way would be grass seeded.

AIR QUALITY

The first item is designed to prevent individual or cumulative effects during burning operations. The next 3 items are designed to reduce effects from burning operations.

- Burning operations would be in compliance with the Montana Airshed Group reporting regulations and any burning restrictions imposed in Airshed 2. This would provide for burning during acceptable ventilation and dispersion conditions.
- Excavator, landing, and roadwork debris would be piled clean to allow ignition to occur during fall and spring when ventilation is good and surrounding fuels are wet. The Forest Officer may require that piles be covered to

reduce dispersed (unentrained) smoke. Covered piles are drier, ignite easier, burn hotter, and extinguish sooner.

- In order to reduce smoke production, the number of burn piles would be minimized by leaving large woody debris on site.
- Dust abatement may be applied on some segments of the Upper Whitefish Road that would be used during hauling; whether dust abatement would be applied depends on the season of harvest and level of public traffic.

SOILS

COMPACTION

- Logging equipment would not operate off forest roads unless:
  - soil moisture is less than 20 percent,
  - Soil is frozen to a depth that would support machine operations, or
  - soil is snow covered to a depth that would prevent compaction, rutting, or displacement.
- Existing skid trails and landings would be used where their design is consistent with prescribed treatments and meets current BMP guidelines.
- Designated skid trails would be required where moist soils or short steep pitches (less than 300 feet) would not be accessed by other logging systems. This would reduce the number of skid trails and the potential for erosion.
- Skid trail density in a harvest area would not exceed 20 percent of the total area in a cutting unit.

SOIL DISPLACEMENT

- Conventional ground-based skidding equipment would not be operated on sustained steep slopes (greater than 40 percent). Soft-tracked yarders are suitable on slopes up to 55 percent with less impact than conventional tractor skidding. Cable yarding would be used on sustained steeper slopes.
- Piling and scarification would be completed with a dozer where slopes are gentle enough to permit. Steeper slopes would have slash treatment and site preparation done by using an excavator or broadcast burning.

EROSION

- Ground skidding machinery would be required to be equipped with winchline to limit equipment operation on steeper slopes.
- Roads used by the purchaser would be reshaped and the ditches redefined prior to and following use to reduce surface erosion.
- Drain dips, open-topped culverts, and gravel would be installed on roads as needed to improve road drainage and reduce maintenance needs and erosion.
- Some road sections would be repaired to upgrade the roads to design standards that reduce erosion potential and maintenance needs.
- The prompt and timely application of certified weed-free grass seed and fertilizer would be applied to newly constructed road surfaces and cut-and-fill slopes. These applications would also be applied to any existing disturbed cut-and-fill slopes and landings immediately adjacent to open roads. These would be done to stabilize soils and reduce or prevent noxious weed establishment, to include:
  - seeding all road cuts and fills concurrent with construction,
  - applying "quick-cover" seed mix within 1 day of work completion at culvert installation sites, and
  - seeding all road surfaces and reseeding culvert installation sites when the final blading is completed for each specified road segment.

- Water bars, logging-slash barriers, and in some cases, temporary culverts would be installed on skid trails where erosion is anticipated, based on ground and weather conditions, as directed by the forest officer. These erosion-control features would be periodically inspected and maintained throughout the contract period or extensions thereof.

NOXIOUS WEED MANAGEMENT

- Surface blading may be required to remove weeds before the seed-set stage on roads affected by the proposal.
- All tracked and wheeled equipment would be cleaned of noxious weeds prior to beginning project operations. The contract administrating officer would inspect equipment periodically during project implementation.
- Prompt revegetation of disturbed roadside sites would be required.
- Roads used and closed as part of this proposal would be reshaped and grass seeded.

ARCHAEOLOGY

A review of the project was conducted by a DNRC archaeologist. A contract clause provides for suspending operations if cultural resources were discovered and operations would only resume as directed by the Forest Officer.

Appendix B

Vegetation Analysis

APPENDIX B
VEGETATION ANALYSIS

INTRODUCTION

This section will provide a description of the present vegetative conditions of the forest and address the potential effects of the proposed alternatives related to the following issues:

- Covertype and age-class distributions through a landscape-level analysis of timber stands.
- Old-growth-stand distribution at a landscape level and old-growth stand attributes.
- Stand development in relation to natural disturbances and management activities.

ANALYSIS METHOD

The SFLM Rules direct DNRC to take a landscape-level or coarse-filter approach to biodiversity. To promote biodiversity, an appropriate mix of stand structures and compositions on State land should be favored (*Montana DNRC 1996*). To implement a coarse-filter approach, landscape analysis techniques were used to determine an appropriate mix of stand structures and compositions based on ecological characteristics, such as landtypes, climatic sections, habitat types, disturbance regimes, and other unique characteristics, on Stillwater State Forest. Covertype representations and age-class distributions are general characteristics shown in the landscape-level analysis.

The analysis will compare the desired stand conditions that DNRC believes to be appropriate for the site with current stand conditions. A forest inventory from the 1930s was used in *Losensky's 1993* data to estimate the proportion of various stand-structure stages by covertype and age class as they were historically represented throughout the Inland Northwest. This provides an estimate of the natural characteristics of forests prior to fire suppression and extensive logging. *Losensky (1997)* worked with DNRC to complete an analysis for the entire State; some vegetation types specific to that work are included in this analysis.

The protocol used to assign covertypes on DNRC forested lands, including Stillwater Unit, is explained in detail in the SFLM Rules (*ARM 36.11.405*). The SLI database used for this analysis is the September 15, 2003 version of "main block and scattered north.dbf" (STW 2003 SLI data). This data is available at the Stillwater Unit office at Olney. The methodology used to analyze current and appropriate stand conditions follows:

Two filters were developed and applied to Stillwater State Forest's SLI data (STW 2003 SLI). The filters were assigned covertypes similar to those used in the inventory of the 1930s. The first filter followed the 1930s criteria exactly, or as closely as possible, representing current conditions. The other filter for appropriate conditions assigns covertypes using criteria primarily designed to help address the situation where succession from one covertype to another was occurring. The successional filter was developed to indicate that those areas in the absence of fire suppression, introduced pathogens, and timber harvesting would likely have been assigned to a different covertype than the current covertype filter would suggest. The appropriate filter then estimates, from the current condition of the stand, what the stand would have looked like in 1900.

The methods to identify old-growth timber stands are initiated from modeling based on the STW 2003 SLI data. The query primarily sorts for stands that meet the age criteria and number of trees greater than a certain dbh based on habitat-type groups; refer to the *GLOSSARY* for DNRC's old-growth definition. Field surveys were used to verify those modeled old-growth stands and determine if additional stands meet the definition within the project area.

The analysis on stand development will be a qualitative discussion of the conditions of timber stands, including how various natural and man-caused disturbances and site factors have affected, and may continue to affect, timber-stand development.

ANALYSIS AREA

The vegetation analysis includes 3 geographic scales:

- Upper Flathead Valley - Historic conditions refer to those from Climatic Section 333C of the Upper Flathead Valley (*Losensky 1997*). For this analysis, the historic conditions for Climatic Section 333C relate to forest covertypes and age-class distributions only.
- Stillwater State Forest management block - Current and appropriate conditions were analyzed on the scale of the entire Stillwater State Forest and scattered outlying sections in northeastern Lincoln County (approximately 100,208 forested acres). Current and appropriate conditions for covertype, age, and old-growth distribution were analyzed at this scale.
- Project level - Stand attributes related to old growth, species composition, and stand development will be analyzed by harvest area.

COVERTYPE

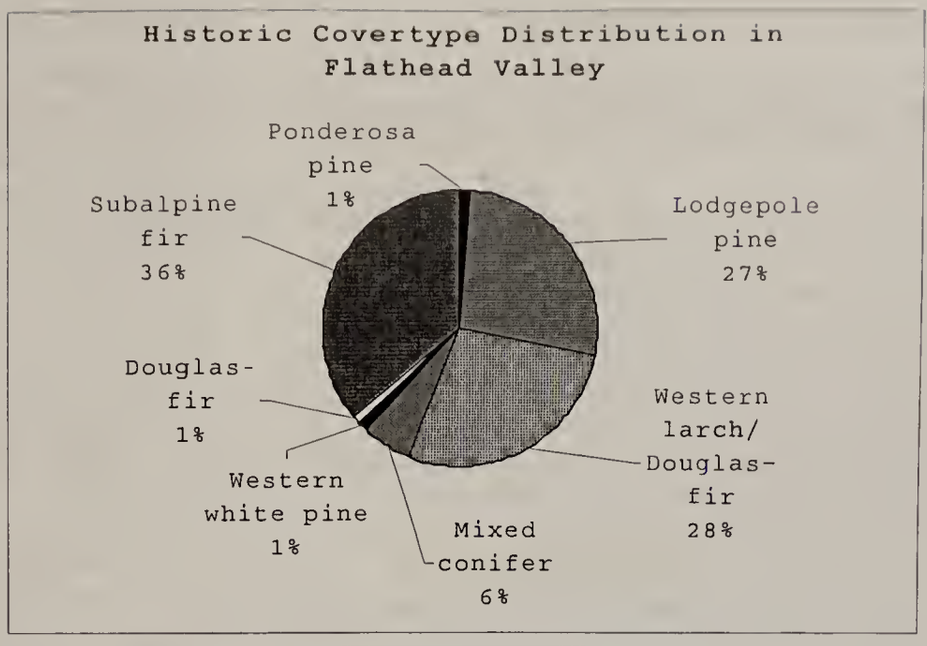
FIGURES B-1 through *B-3 - PERCENTAGE OF FORESTED ACRES BY COVERTYPE* illustrate the percentage of forested ground that is/was occupied by a particular covertype. The comparison shown includes the Upper Flathead Valley historic covertype data and current and appropriate covertype conditions on the scale of the analysis area (Stillwater Unit). The chart displaying historic conditions is from *Lozensky's* data and covers forested types of a much larger scale than do the current and appropriate conditions.

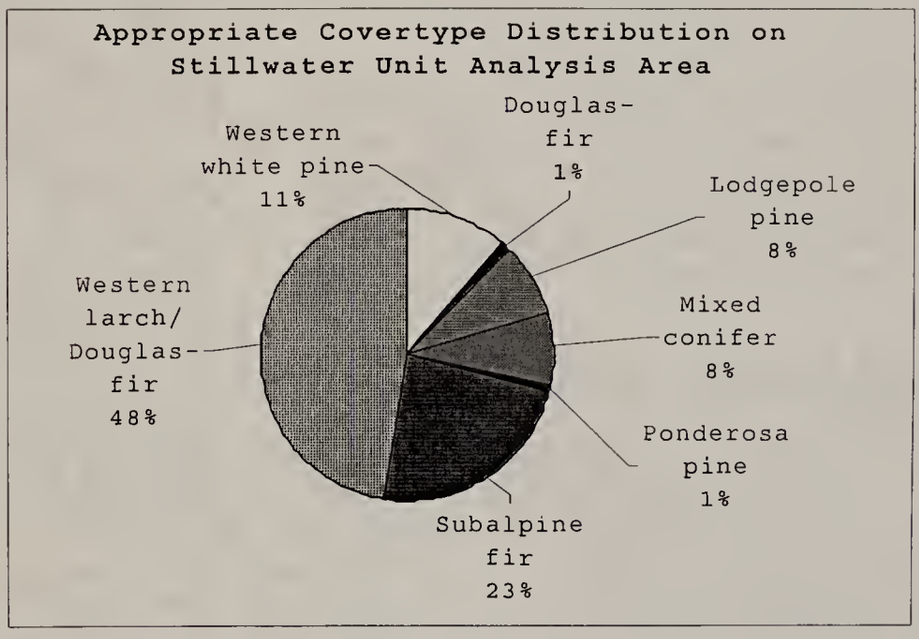
Data indicates, as illustrated by *FIGURES B-2 and B-3*, that mixed-conifer stands are currently overrepresented in reference to both historic conditions and conditions that DNRC feels appropriate by using historic data (desired future covertype conditions). Many of the species that make up the mixed-conifer covertype are shade tolerant and their representation increases as the intervals between disturbances, such as wildfires, lengthens.

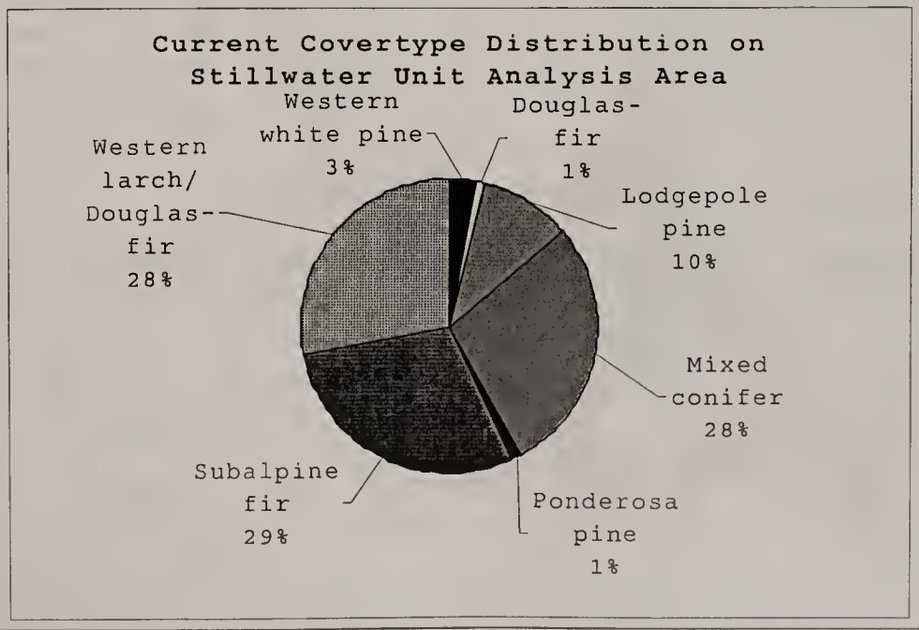
The western larch/Douglas-fir and lodgepole pine covertypes are currently underrepresented on the forest in reference to historic data; western larch and lodgepole pine are not shade tolerant and, historically, the species have been perpetuated through fairly intensive disturbances, such as wildfires.

The data sort indicates the amount of western white pine covertype is slightly lower than what occurred historically. The white pine blister rust infection has drastically affected the western white pine. In reality, the number of healthy western white pine that occupy the canopy as overstory dominants has been on the decline across most of the Pacific Northwest for several decades.

FIGURES B-1 THROUGH B-3 - PERCENTAGE OF FORESTED ACRES BY COVERTYPE ON STILLWATER UNIT







AGE-CLASS DISTRIBUTION

Age-class distributions delineate another characteristic important for determining trends on a landscape level.

Inventories of the 1930s quantified the ages of the forest stands. To arrive at age estimates, *Losensky* examined the data and projected the stands back in time to the early 1900s. This data is useful in setting baseline conditions for determining the extent that current forest age-class distribution deviates from average historical conditions.

Comparing the entire Stillwater State Forest with historical data from the Upper Flathead Valley, *TABLE B-1 - DISTRIBUTION OF AGE CLASSES ON THE CONTIGUOUS STILLWATER STATE FOREST* shows that Stillwater State Forest is low in stands of the seedling-sapling age class and higher is stands that are in the 40-years-and-older age classes.

TABLE B-1 - DISTRIBUTION OF AGE CLASSES ON THE CONTIGUOUS STILLWATER STATE FOREST

AGE CLASS	HISTORIC PERCENT	CURRENT PERCENT
0 to 39 years	36	10
40 to 99 years	12	23
100 to 150 years	22	19
150+ years	29	48

OLD GROWTH

OLD-GROWTH DISTRIBUTION

Old growth, for this analysis, is defined as stands that meet the minimum criteria (number of trees per acre that have a minimum dbh and a minimum age) for a given site (old-growth group from habitat type). The criteria can be found in *Green et al (Old Growth Forest Types of the Northern Region)*. Based on the SLI data, field surveys within the project area, and the effects of other timber sales on SLI old-growth data, approximately 8,679 acres, or 8.7 percent of the coarse-filter analysis area can be classified as old-growth. No field-verified old growth or SLI potential old growth has been identified in the northern scattered sections; therefore, those areas are not displayed in *FIGURE B-4 - OLD-GROWTH ON MAIN BLOCK OF STILLWATER STATE FOREST*.

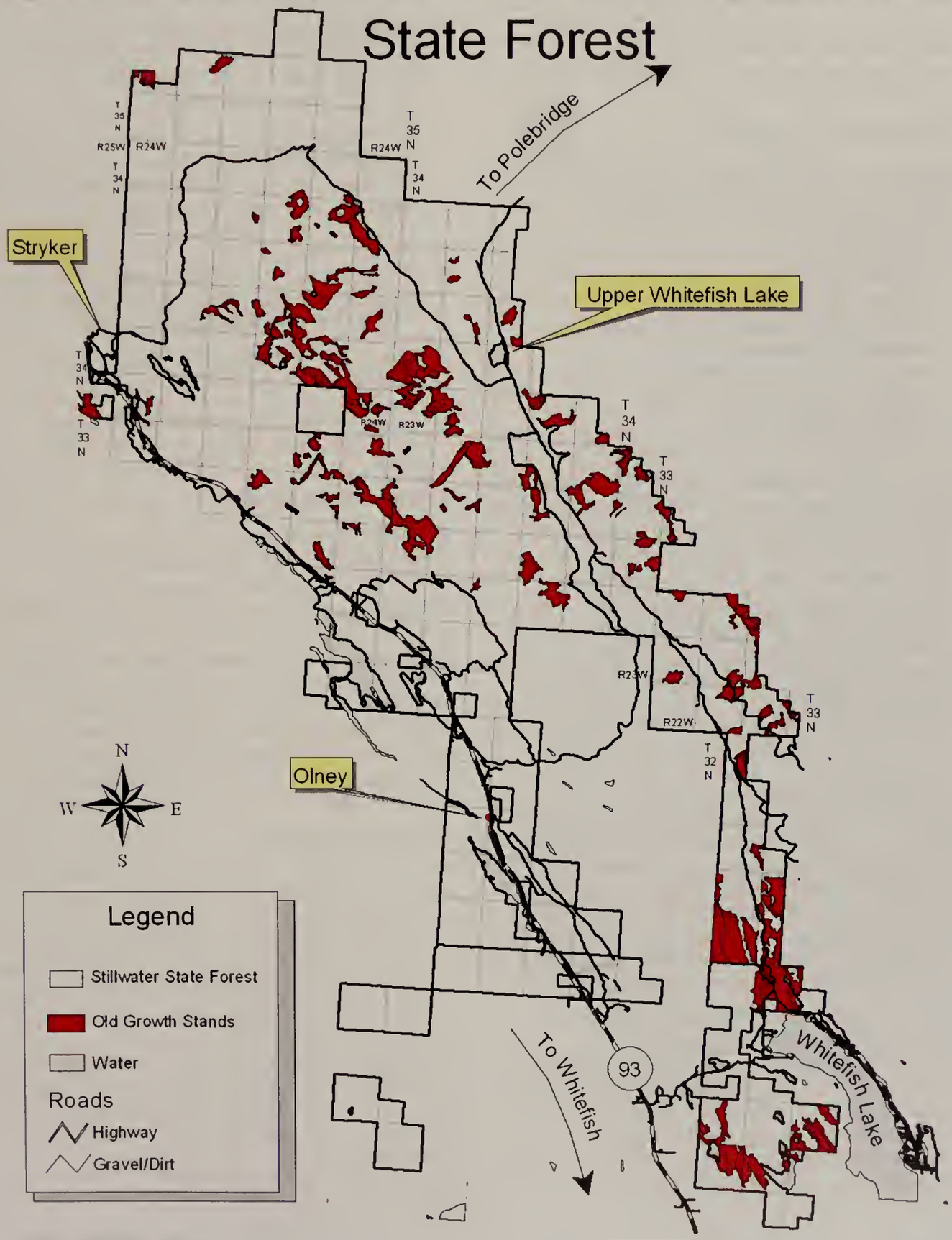
FIGURE B-5 - OLD-GROWTH ACRES BY COVERTYPE ON THE STILLWATER UNIT ANALYSIS AREA and *TABLE B-2 - OLD-GROWTH ACRES BY COVERTYPE* display old growth by forest covertype. Covertype is related to habitat type, habitat-type groups, and successional stages. Covertype is used when presenting old growth because the amount can be correlated to Lozensky's historic information. Subalpine fir and western larch/Douglas-fir (as displayed below in *TABLE B-2 – OLD-GROWTH ACRES BY COVERTYPE*) are the 2 dominant old-growth covertypes on Stillwater State Forest.

TABLE B-2 - OLD-GROWTH ACRES BY COVERTYPE

CURRENT COVERTYPE	DOUGLAS-FIR	LODGEPOLE PINE	MIXED CONIFER	SUBALPINE FIR	WESTERN LARCH/ DOUGLAS-FIR	WESTERN WHITE PINE	TOTALS
Gross acres by SLI	44	398	1,802	3,139	2,432	481	8,296
Old growth confirmed by West Fork Project			183	200			383
Totals	44	398	1,985	3,339	2,432	481	8,679

FIGURE B-4

Old Growth on Main Block of Stillwater State Forest



Old growth within the project area can be viewed in *FIGURE B-5 - WEST FORK OLD-GROWTH MAP* under *ALTERNATIVE EFFECTS (page B-12)*. In addition to old-growth stands identified by SLI in the project area, approximately 383 field-verified acres of old growth have been identified.

OLD-GROWTH ATTRIBUTES

DNRC is in the process of developing a tool to assign old-growth attribute levels to stands by sorting SLI data. The attributes considered are:

- number of large live trees,
- amount of coarse woody debris,
- number of snags,
- amount of decadence,
- multi-storied structures,
- gross volume, and
- crown density.

This data sort assigns a value or an index rating to an old-growth stand that indicates its total score. These scores can be grouped into low, medium, and high categories. This provides an indication of the condition of the stand in reference to attributes that are often associated with old-growth timber stands. These attribute levels are not necessarily an indication of quality, but are tools to compare and classify a collection of older stands over the landscape. The expected variation of levels are based on numerous factors, including habitat groups, tree species, covertype, altitude, past management activities, and proximity to roads. Many of these attributes will relate to wildlife and be discussed within *APPENDIX E - WILDLIFE ANALYSIS*.

Within the project area, the attribute index ratings are primarily medium. The SLI category for most of the field-verified, old-growth stands was low, but based on data collected on these areas (number of larger diameter trees per acre and gross volume per acre), those stands should be within the medium attribute levels.

Some old-growth characteristics within the project area are:

- Engelmann spruce and subalpine fir are the dominant tree species in all of the old-growth stands, which total 777 acres.
- Whitebark pine is a component of the overstory and snag attributes in 7 old-growth stands, which amounts to approximately 313 acres.
- The stand structures are all multistoried, with seedlings to large sawtimber-sized trees.
- Vigor is average to poor in all stands.
- Snag levels are generally high, with greater than 3 snags per acre.

STAND DEVELOPMENT

Natural processes of stand development and disturbance are influenced by environmental conditions and site characteristics, such as soils, stand covertype, forest health, elevation, and stand structure. The stand structures and species component can be greatly modified by natural disturbances, such as wildfire and blowdown events, as well as past management activities.

STAND COVERTYPE

Site factors, such as soil type, aspect, elevation, growing season, and moisture availability, are combined to develop habitat-type classifications, which are then used to describe successional development and timber productivity, among other things *(Pfister et al, 1977)*. For the project area, 95 percent of the acreage is categorized in the "cool and moist" habitat group and currently 99 percent of the area is represented by the subalpine fir and mixed-conifer covertypes.

TIMBER-STAND HEALTH

Damage and mortality from insects and diseases are relatively minor in forest types that exist in this area. A rise has occurred in the incidence of western balsam bark beetles, mountain pine beetles, and white pine blister rust, as well as minor levels of infestations of spruce bark beetles, Douglas-fir beetles, and fir engravers. Indian paint fungus is common in subalpine fir throughout this area. In addition to the insects and pathogens listed above, trees throughout the project area have mechanical damage caused by previous logging, as well as damage caused by wind, snow, and ice, which has allowed rot to develop in the boles of the trees and value to be lost. Also, stands where tree crowns appear sparse and ratty reflect poor vigor and slow growth.

ELEVATION/ASPECT

The elevation of a stand has great importance in determining not only what tree and shrub species are present, but also how fast or slow changes take place. Elevations in the project area range from 4,300 feet to 6,500 feet above sea level. Based on measurements taken over the last 27 years, the average snow depth for the Herrig snow-course survey, which is located in Harvest Area II-P, is 65 inches. A large portion of the project area has a northeast aspect. This exposure, together with high elevations, account for the high moisture availability, as well as the long duration snow is on the ground. These 2 factors, elevation and aspect, are also the main reason for the presence of whitebark pine. Within the project area are a total of 882 acres in 18 stands that have whitebark pine older than 150 years in the upper level canopy.

STAND STRUCTURE

Stand structure indicates a characteristic of stand development and how the stand will continue to develop.

Single-storied stands are most often associated with stand-replacement events, such as severe fires or clearcut harvesting.

Two-storied stands are often associated with areas of less severe fire and usually have more fire-resistant trees, such as western larch or Douglas-fir, left in the overstory. Regeneration harvests that retain approximately 10 percent crown cover in the overstory and have seedling/sapling understory are also classified as 2-storied stands.

The multistoried condition arises when a stand has progressed through time and succession to the point that shade-tolerant species are replacing a shade-intolerant overstory. Often a long interval of time occurs between major disturbances.

TABLE B-1 - PERCENT OF STAND STUCTURES IN THE PROJECT AREA AND ENTIRE STILLWATER STATE FOREST displays the percent of stands in the single-storied, two-storied, and multistoried levels on Stillwater Unit and within the project area.

TABLE B-1 - PERCENT OF STAND STUCTURES IN THE PROJECT AREA AND ENTIRE STILLWATER STATE FOREST

STAND STRUCTURE	STILLWATER UNIT	PROJECT AREA
Single-storied	18%	6%
Two-storied	6%	Trace
Multistoried	76%	93%

PAST MANAGEMENT ACTIVITIES

Engelmann spruce and subalpine fir have always been the predominate species in the project area. According to past inventory records, western larch, Douglas-fir, and western white pine were present in many of the stands in Harvest Area II, as they are today, but Engelmann spruce and subalpine fir have always been the predominate species. In Harvest Area III, the seral species are a minor component with less than 15 percent canopy composition.

Major timber harvesting has been ongoing in the project area since the late 1940s. Many of the stands in Harvest Area II were selectively logged in the late 1940s and early 1950s, targeting Douglas-fir, Engelmann spruce, and western larch, where available, for use as railroad ties. Minimal site preparation was completed following harvesting; therefore, the progression of these stands leans toward the shade-tolerant species of Engelmann spruce and subalpine fir.

Over time, salvage logging has occurred in many of the stands in order to remove blowdown or beetle-infested trees, mainly Engelmann spruce.

Overall, there are approximately 1,600 acres in the project area that had more than 30-percent crown removal. Most (76 percent) of the acres were harvested in the 1950s and 24 percent was salvaged and clearcut. Where the ground was scarified, desired tree species were able to regenerate. However, without scarification and planting, many of these areas were taken over by shrub species, causing regeneration to be slow and limited.

FIRE REGIMES

The fire regimes across Stillwater State Forest are variable. The forest, as a whole, has a mosaic pattern that developed from different fire frequencies and intensities. Areas of frequent fire have produced a Douglas-fir, western larch, and ponderosa pine covertype. As the intervals between fires become longer, the more shade-tolerant species (Engelmann spruce, subalpine fir, grand fir, western hemlock, and western red cedar) begin to develop. The higher elevations within the forest have longer fire intervals and the stands tend to be multistoried with a dominant shade-tolerant covertype. Where fire frequencies were short, the stands are open, single-storied, and, occasionally, 2-storied. With the arrival of aggressive fire-suppression efforts, covertypes and fire frequencies were altered. Stands of ponderosa pine, western larch, and/or Douglas-fir have become multistoried with shade-tolerant species. Stands that were once open, now have a thick understory of predominantly Douglas-fir, grand fir, Engelmann spruce, and subalpine fir. Fires are generally kept small, limiting natural fire effects. If a large-scale fire were to occur, many acres could be affected due to ladder fuels, heavy fuel accumulation, and other environmental factors.

The West Fork Timber Sale Project area is primarily represented by Fire Group 9 Fire Regime (87 percent of the project area gross acreage), with minor representation in Fire Groups 10 (8 percent), 8 (5 percent), and 7 (less than 1 percent) (*Fischer and Bradley, 1987*). All stands in Harvest Area II and most stands in Harvest Area III fall into Fire Group 9. Fire Group 9 represents moist, lower subalpine habitat types where fires are infrequent, but severe, and the effects are long lasting. Fire-free intervals range from 117 years in

valleys to more than 146 years on lower alpine slopes. Within the project area, stand-replacing fires have been estimated to occur at moderately long to long intervals, 150 to 300 years. Fire history information for subalpine fir habitat types is limited, particularly for moist Fire Group 9 sites. Available evidence indicates that fires on such sites are infrequent and are mostly either low severity or stand replacing. Moderately severe fires are apparently less frequent, although they do occur. Therefore, the size of the fires in this fire regime will vary from small in the less severe fire conditions to large in the more severe fire conditions that have been experienced lately, where thousands of acres in the later successional stages are burned in a stand-replacement fire.

The next most common fire regime in the project area is Fire Group 10, which is characterized by high-elevation forests near and at timberline. Some stands in Harvest Area III are in this regime. Stand-replacing fires even in the more continuous forests range in frequency to more than 300 years.

Fire Group 8 consists of dry, lower subalpine habitat types where Engelmann spruce, subalpine fir, or mountain hemlock are the indicated climax species. This group experiences more frequent fires that are generally less severe than Fire Group 9. Intervals range from 50 years in lodgepole pine stands to 130 years for the more moist, lower subalpine types.

No harvest areas are proposed in Fire Group 7; this group is less than 1 percent of the project area; therefore, this group will not be discussed further.

ALTERNATIVE EFFECTS

COVERTYPES AND AGE CLASSES

Direct Effects

- ***Direct Effects of No-Action Alternative A to Covertypes and Age Classes***

  Covertypes and age classes on Stillwater State Forest would not be directly affected.

- ***Direct Effects of Action Alternative B to Covertypes and Age Classes***

  This alternative proposes:

  - a commercial-thin harvest on 73 acres in Harvest Area I.
  - regeneration harvests, including group-selection and overstory-removal treatments, on approximately 1,174 acres in Harvest Areas II and III.

  Approximately 138 acres of the mixed-conifer covertype would likely be converted to a western larch/Douglas-fir covertype through the planting of western larch or the harvesting of subalpine fir and Engelmann spruce during harvesting. An additional 351 acres of the subalpine fir covertype and 779 acres of the mixed-conifer covertype would be harvested, but no change in covertype is expected. The representation of western larch and western white pine would likely increase due to planting; Douglas-fir and whitebark pine representation should remain similar to current numbers.

  With the group-selection/overstory-removal treatments planned for Harvest Area II, approximately 713 acres would be regenerated and 153 acres would be retained in a stocked stand of saplings and pole-sized trees in the 40-to-99-year age class. Approximately 190 acres would change from the 40-to-99-year age class to 0 years, 160 acres would change from the 100-to-150-year age class to 0 years, and 695 acres would change from

the old-stand age class to 0 years.

Following the site preparation and planting of Harvest Areas II and III, the representation of the 0-to-39-year age class on Stillwater Unit would increase by 1 percent, or 1,045 acres, and the representation of 150+-year-old stands would be reduced by 0.7 percent.

- ***Direct Effects of Action Alternative C to Covertypes and Age Classes***

  Action Alternative C proposes a commercial-thin harvest on 73 acres and group-selection and overstory-removal treatments on approximately 866 acres.

  Through the planting or removal of subalpine fir and Engelmann spruce during the thinning harvest, approximately 46 acres of the mixed-conifer covertype would likely be converted to the western larch/Douglas-fir covertype. Approximately 139 acres of the subalpine fir and 753 acres of the mixed-conifer covertypes would be harvested, but no covertype change is expected. The representation of western larch and western white pine would likely increase due to planting; Douglas-fir and whitebark pine representation should remain similar to the current numbers.

  With the group-selection/overstory-removal treatments planned for Harvest Area II, approximately 713 acres would be regenerated and 153 acres would be retained in a stocked stand of saplings and pole-sized trees in the 40-to-99-year age class. Approximately 190 acres would change from the 40-to-99-year age class to 0 years, 160 acres would change from the 100-to-150-year age class to 0 years, and 695 acres would change from the 363-stand age class to 0 years.

  Following the site preparation for Harvest Areas II, the representation of the 0-to-39-year age class on Stillwater Unit would increase by 0.7 percent or 713 acres and the representation of 150+-year-old stands would be reduced by 0.4 percent.

Indirect Effects

- ***Indirect Effects of No-Action Alternative A to Covertypes and Age Classes***

  Overtime, natural forest succession and fire suppression would reduce the variability of covertypes and age classes, thus, reducing biodiversity.

- ***Indirect Effects of Action Alternative B to Covertypes and Age Classes***

  Harvesting trees would move the representation of age classes and covertypes would move representation toward historical distribution. In total, representation of the 0-to-39-year age class on Stillwater State Forest would increase by 1 percent, or 1,045 acres, and the old-stand representation would be reduced by 0.7 percent.

- ***Indirect Effects of Action Alternative C to Covertypes and Age Classes***

  The representation of age classes and covertypes would move representation toward historical distribution. In total, representation of the 0-to-39-year age class on Stillwater State Forest would increase by 0.7 percent, or 713 acres, and the 150-year-age-class representation would be reduced by 0.4 percent.

Cumulative Effects

- ***Cumulative Effects of All Alternatives to Covertypes and Age Classes***

  The cumulative effects of timber-stand management on Stillwater State Forest is a trend toward increasing seral covertypes in areas where recent forest-management activities have taken

place. Since the Chicken/Werner Timber Sale Project EIS in 1999, the western larch/Douglas-fir covertype has increased by 6 percent.

In addition to the changes in covertype distributions from the proposed alternatives, other timber sale projects have been initiated, but have not been completed; therefore, their effects are not represented in the STW 2003 SLI. Scheduled updates of the SLI will begin to capture the trend toward more western larch/Douglas-fir, lodgepole pine, and western white pine covertypes on Stillwater State Forest, as well as the trend toward increasing the amount of acres in the 0-to-39-year age class.

OLD-GROWTH DISTIRBUTION AND ATTRIBUTES

Direct Effects

- ***Direct Effects of No-Action Alternative A to Old-Growth Distribution and Attributes***

  The distribution or attributes of old-growth stands would not be affected.

- ***Direct Effects of Action Alternative B to Old-Growth Distribution and Attributes***

  Approximately 286 acres of old-growth would be harvested with regeneration treatments on areas typically suited to stand-replacement fire regimes. The posttreatment timber stand would no longer meet DNRC's criteria for old growth. Those portions of the original stand that are not harvested would likely continue to meet DNRC's old-growth definition. Implementation of Action Alternative B would decrease Stillwater Unit's old-growth levels by 286 acres and retain an estimated 8,393 acres of potential old growth. This harvest would remove 118 acres from the mixed-conifer covertype and 168 acres from the subalpine fir covertype.

  FIGURE III-6 - WEST FORK OLD-GROWTH MAP (next page) shows the locations where harvesting would affect the distribution of old-growth stands.

  Most attributes associated with old-growth stands would be removed. Structure would be retained in small areas where existing trees would not be harvested, such as near springs, areas not feasible to skid or yard, or areas marked with leave trees. A minimum of 1 large (greater than 21-inches dbh) snag and 1 large-diameter snag-recruitment tree per acre would be retained within the harvest areas. If no snags this size are available, the next largest size would be retained. In addition to live recruitment trees, up to 10 western larch, Douglas-fir, and whitebark pine trees suitable for seed dispersal per acre would be retained.

- ***Direct Effects of Action Alternative C to Old-Growth Distribution and Attributes***

  The distribution or attributes of old-growth stands would not be affected.

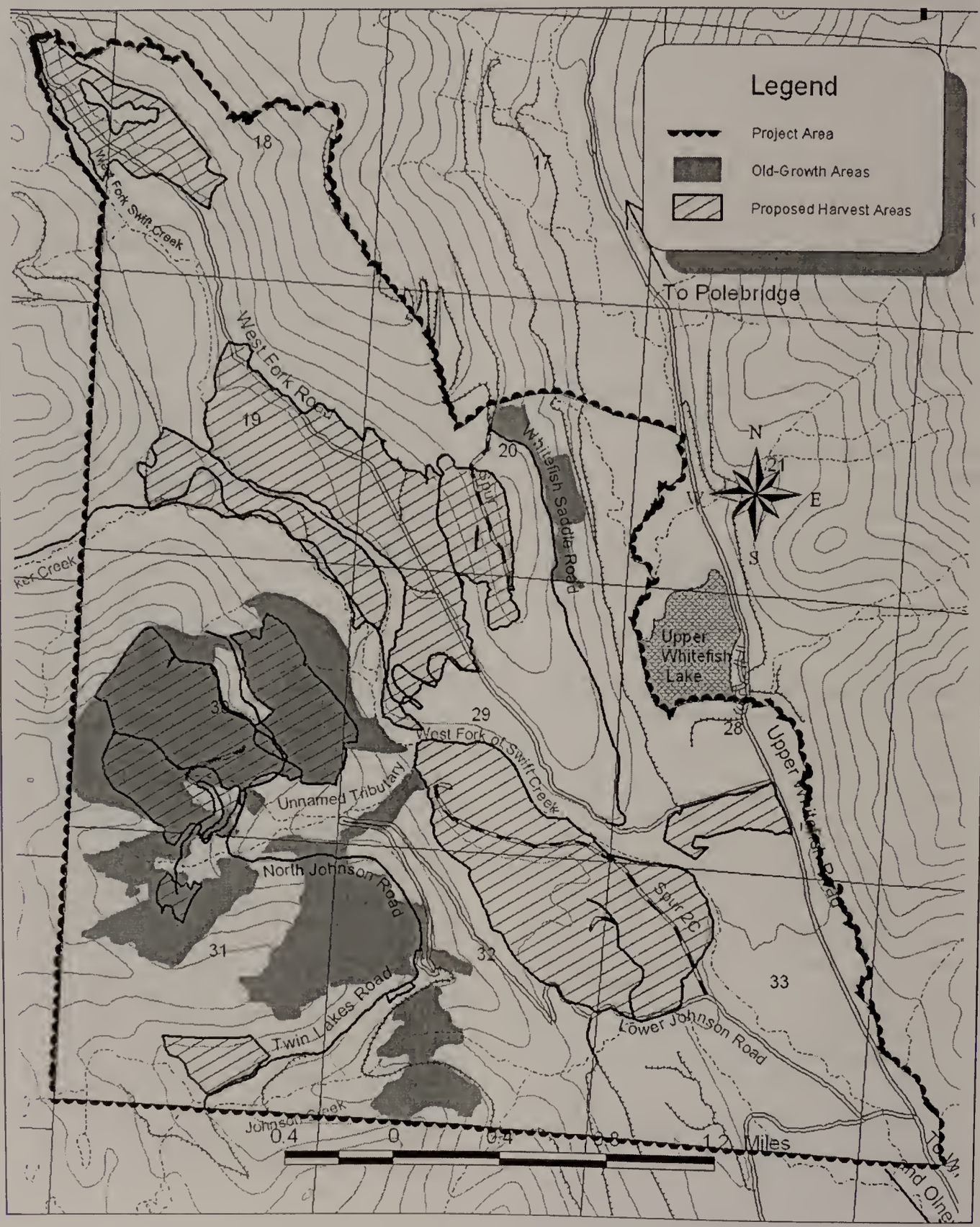
Indirect Effects

- ***Indirect Effects Common of All Alternatives to Old-Growth Distribution and Attributes***

  Stands currently meeting DNRC's old-growth definition would become more decadent. Stocking levels and the loading of down woody debris would increase in some stands and covertypes, increasing wildfire hazards. Shade-tolerant species would remain dominant in stands. Various factors, such as insects, diseases, and decreasing vigor, would eventually cause more snags to occupy portions of the stands. Within the project area, white pine blister rust, mountain pine beetles, and weather-related damage has increased the amount of snags in old-growth stands.

Figure B-5

WEST FORK OLD-GROWTH MAP



- ***Indirect Effects of Action Alternative B to Old-Growth Distribution and Attributes***

  Action Alternative B would harvest timber near old-growth stands and structurally create more abrupt stand edges. Potentially, the risk of blowdown along the proposed unit boundaries would increase. Harvest areas next to old-growth stands could possibly act as fuel breaks, which could slow or stop wildfires before they could burn the old-growth.

Cumulative Effects

- ***Cumulative Effects Common to All Alternatives to Old-Growth Distribution and Attributes***

  Approximately 48 acres of field-verified old growth are planned for harvesting in Sections 20, 29, and 32 Township 32 north, Range 22 west with the Taylor South Timber Sale Project EIS covered the harvesting of these acres. Approximately 104 acres of old growth, both field verified and SLI identified, have been harvested in the Chicken/Werner Timber Sale Project area. In total, an estimated 59 acres of old growth would be removed from the mixed-conifer covertype, 81 acres from the western white pine covertype, and 12 acres from the Douglas-fir covertype.

  SLI originally classified these 152 acres as having medium attribute levels. These stands would no longer meet DNRC's old-growth definition following harvesting, and, at the most, they would have low attributes.

- ***Cumulative Effects Common of No-Action Alternative A and Action Alternative C to Old-Growth Distribution and Attributes***

  The estimated acres of old-growth on Stillwater Unit would be reduced to 8,527 acres; approximately 8.5 percent of the analysis area. The percentage of old-growth acres by covertype would change very little.

- ***Cumulative Effects of Action Alternative B to Old-Growth Distribution and Attributes***

  Old-growth on Stillwater Unit would be reduced to an estimated 8,241 acres; approximately 8.2 percent of the analysis area. The representation of the mixed-conifer old-growth area would be reduced by about 2 percent; the representation of both the western larch/Douglas-fir and subalpine fir covertypes would increase by approximately 1 percent.

STAND DEVELOPMENT

Direct Effects

- ***Direct Effects of No-Action Alternative A to Stand Development***

  Stand development within the project area would not be directly affected.

- ***Direct Effects of Action Alternative B to Stand Development***

  This alternative would directly affect stand development by taking on the role of a stand-replacing fire in Area III, and a moderately-severe fire in Area II; a vegetative mosaic would be created by removing some overstory trees and reducing fuels. The climax species of Engelmann spruce and subalpine fir, which are easily killed by fire, would be removed, thereby allowing the regeneration of those species that require more sunlight. This alternative would likely convert approximately 138 acres of the mixed-conifer covertype to the western larch/Douglas-fir covertype (see *Direct Effects to Covertypes and Age Classes*). By removing trees that are affected by insects and diseases, the vigor and health of the residual trees, adjacent stands, and future forest would all be directly affected.

  In stands with whitebark pine, the desired future condition is a healthy, virile stand of trees with some degree of rust resistance. The cones and seeds

from these trees are beneficial to wildlife. The regeneration harvests, and subsequent site preparation, in Areas II and III would enhance the regeneration of the seral species. The seral species are western larch, Douglas-fir, and western white pine in the stands of lower elevation, and whitebark pine in the higher elevations. Broadcast burning would be a benefit for reestablishing whitebark pine in these stands.

- ***Direct Effects of Action Alternative C to Stand Development***

  This alternative would directly affect stand development by taking on the role of a moderately-severe fire in Area II, creating a vegetative mosaic by removing some overstory trees, and reducing fuels. The climax species of Engelmann spruce and subalpine fir, easily killed by fire, would be removed, thereby allowing the regeneration of those species that require more sunlight. Action Alternative C would likely convert approximately 46 acres of the mixed-conifer covertype to the western larch/Douglas-fir covertype (see *Direct Effects to Covertypes and Age Classes*). By removing trees that have been affected by insects and diseases, the vigor and health of the residual trees, present adjacent stands, and future forest would all be directly affected.

  The regeneration harvests, and subsequent site preparation, in Area II would enhance the regeneration of the seral species. The seral species are western larch, Douglas-fir, and western white pine.

Indirect Effects

- ***Indirect Effects of No-action Alternative A to Stand Development***

  As stands age over time, natural forest succession and fire suppression would reduce the variability of covertypes both on the forest landscape and in the project area. Coupled with the effects of mountain pine beetles and white pine blister rust, the representation of whitebark pine would diminish over the landscape, and the benefits to wildlife would diminish as well. Engelmann spruce and subalpine fir would continue to replace the seral species until a stand-replacing fire someday develops and allows the process of succession to begin again. Hundreds of years may pass before this happens. With current fire-suppression efforts, surface fires that act as underburns would more likely occur, reducing fuels and killing some overstory trees. Less frequent, more severe fires could occur over small areas, but their effect would usually be limited to the creation of vegetative mosaics.

- ***Indirect Effects of Action Alternative B to Stand Development***

  In Area III, logging takes on the role of a stand-replacing fire that probably would not naturally occur except at 150- to 300-year intervals. The shade-tolerant climax species (Engelmann spruce and subalpine fir) are removed, shrub competition is reduced, and some soil is exposed to allow the seeds from the more shade-intolerant species of whitebark pine, western larch, and Douglas-fir to germinate.

  All proposed harvest units in Area II are in the Fire Group 9 fire regime, where logging imitates more of a moderately-severe fire. A fire in this regime is less intense, but still effective in removing the shade-tolerant and

Appendix C

Watershed & Hydrology Analysis

APPENDIX C
WATERSHED AND HYDROLOGY ANALYSIS

INTRODUCTION

SEDIMENT DELIVERY

Timber harvesting and related activities, such as road construction, can lead to water-quality impacts by increasing the production and delivery of fine sediment to streams. The construction of roads, skid trails, and landings can generate and transfer substantial amounts of sediment through the removal of vegetation and exposure of bare soil. In addition, removal of vegetation near stream channels reduces the sediment-filtering capacity and may reduce channel stability and the amounts of large woody material. Large woody debris, which creates natural sediment traps and energy dissipaters to reduce the velocity and erosiveness of stream flows, is a very important component of stream dynamics.

WATER YIELD

Timber harvesting and associated activities can affect the timing, distribution, and amount of water yield in a harvested watershed. Water yields increase proportionately to the percentage of canopy removal, because removal of live trees reduces the amount of water transpired, leaving more water available for soil saturation and runoff. Canopy removal also decreases interception of rain and snow and alters snowpack distribution and snowmelt, which lead to further water-yield increases. Higher water yields may lead to increases in peak flows and peak-flow duration, which can result in accelerated streambank erosion and sediment deposition.

ANALYSIS METHODS

SEDIMENT DELIVERY

Methodology for analyzing sediment delivery was completed using a sediment-source inventory. Roads and stream crossings within the project area were evaluated to determine sources of introduced sediment. In addition, in-channel sources of sediment were identified using channel-stability rating methods developed by *Pfankuch* and through the conversion of stability rating to reach condition by stream type developed by *Rosgen (1990)*. These analyses were conducted in 1999 by a contracted firm and verified by a DNRC hydrologist. In addition, data was collected in 2003 to quantify sediment delivery using procedures adapted from the *Washington Forest Practices Board (Callahan, 2000)*.

WATER YIELD

The water-yield increase for the watershed in the project area was determined using the equivalent clearcut area (ECA) method as outlined in *Forest Hydrology Part II (1976)*. ECA is a function of total area roaded and harvested, percent of crown removal in harvesting, and amount of vegetative recovery that has occurred in harvested areas. This method equates area harvested and percent of crown removed with an equivalent amount of clearcut area. For example, if 100 acres had 60 percent crown removed, ECA would be approximately 60, or equivalent to a 60-acre clearcut. The relationship between crown removal and ECA is not a 1-to-1 ratio, so the percent ECA is not always the same as the percent of canopy removal. As live trees are removed, the water they would have evaporated and transpired either saturates the soil or is

translated to runoff. This method also calculates the recovery of these increases as new trees vegetate the site and move toward preharvest water use.

In order to evaluate the watershed risk of potential water-yield increase effectively, a threshold of concern must be established. In order to determine a threshold of concern, acceptable risk level, resource value, and watershed sensitivity are evaluated according to *Young (1989)*. The watershed sensitivity is evaluated using qualitative assessments, as well as procedures outlined in *Forest Hydrology Part II (1976)*. The stability of a stream channel is an important indicator of where a threshold of concern should be set. As water yields increase as a result of canopy removal, the amount of water flowing in a creek gradually increases. When these increases reach a certain level, the bed and banks may begin to erode. The more stable streams will be able to handle larger increases in water yield before they begin to erode, while less stable streams will experience erosion at more moderate water-yield increases.

ANALYSIS AREA

SEDIMENT DELIVERY

The analysis area for sediment delivery is the West Fork Timber Sale project area and the proposed haul routes. The West Fork watershed is a 10,669-acre, perennial, third-order tributary to Swift Creek and Whitefish Lake and includes Stryker Creek. The Antice/Johnson watershed is a 7,289-acre tributary to Swift Creek. Analysis will cover stream segments within these watersheds that may be affected by the proposed project and all roads and upland sites that may contribute sediment to the West Fork or Johnson Creek.

WATER YIELD

The analysis area for water yield is the West Fork and Antice/Johnson Creek watersheds. Precipitation in both watersheds range from 30 inches in the Antice/Johnson watershed in the lower elevations to 80 inches at the ridgetops. In addition, the water yield of the entire Swift Creek watershed will be analyzed to determine the effects of the proposed project on the receiving waters.

EXISTING CONDITIONS

REGULATORY FRAMEWORK

Montana Surface Water-Quality Standards

According to *ARM 17.30.608 (1)(c)*, the Whitefish Lake drainage, including Swift Creek, is classified as A-1. Among other criteria for A-1 waters, no increases are allowed above naturally occurring levels of sediment or turbidity. "Naturally occurring," as defined by *ARM 17.30.602 (17)*, includes conditions or materials present during runoff from developed land where all reasonable land, soil, and water conservation practices (commonly called BMPs) have been applied. Reasonable practices include methods, measures, or practices that protect present and reasonably anticipated beneficial uses. These practices include, but are not limited to, structural and nonstructural controls and operation and maintenance procedures. Appropriate practices may be applied before, during, or after completion of potentially impactive activities.

Designated beneficial water uses within the project area include cold-water fisheries and recreational use in the streams, wetlands, lake, and surrounding area.

Water-Quality-Limited Waterbodies

Swift Creek and the West Fork of Swift Creek are currently listed as a water-quality-limited waterbodies in the 1996 and 2004 303(d) list. The 303(d) list is compiled by DEQ as required by Section 303(d) of the Federal Clean Water Act and the Environmental Protection Agency (EPA) Water Quality Planning and Management Regulations (*40 CFR, Part 130*). Under these laws, DEQ is required to identify waterbodies that do not fully meet water-quality standards, or where beneficial uses are threatened or impaired. These waterbodies are then characterized as "water-quality limited" and thus targeted for TMDL development. The TMDL process is used to determine the total allowable amount of particulates in a waterbody of the watershed. Each contributing source is allocated a portion of the allowable limit. These allocations are designed to achieve water-quality standards.

The Montana Water Quality Act (*MCA 75-5-701-705*) also directs the DEQ to assess the quality of State waters, ensure that sufficient and credible data exists to support a 303(d) listing, and develop TMDL for those waters identified as threatened or impaired. Under the Montana TMDL Law, new or expanded nonpoint-source activities affecting a listed waterbody may commence and continue provided they are conducted in accordance with all reasonable land, soil, and water conservation practices and BMPs. TMDLs have not been completed for the Swift Creek or West Fork drainages. DNRC will comply with the Law and interim guidance developed by DEQ through implementation of all reasonable soil and water conservation practices, including BMPs and Forest Management Rules.

The current listed causes of impairment in Swift Creek are bank erosion, nutrients, other habitat alterations, and nutrients. The probable source for Swift Creek is listed as silviculture. Current listed causes of impairment in the West Fork are flow alteration, other habitat alteration, and siltation. The probable sources for the West Fork are listed as silviculture and highway maintenance and runoff.

Montana SMZ Law

By the definition in ARM 36.11.312 (3), the majority of the West Fork and Johnson Creek watersheds are Class 1 streams. Johnson Creek, the West Fork, and many of their tributaries have flow for more than 6 months each year. Many of these stream reaches also support fish. Some of the smaller first-order tributaries may be classified as Class 2 or 3 based on site-specific conditions.

SEDIMENT DELIVERY

According to field reconnaissance in the summers of 1999, 2000, and 2003, stream channels in the West Fork watershed are primarily in good to fair condition. Six reaches were rated in poor condition. These 6 reaches represent approximately 7 percent of the identified reaches in the West Fork, and approximately 16 percent of the total length of streams in the watershed. The primary reason for poor reach ratings is movement of channel-bed material. Most reaches of channel were rated as B3 and B4 channels by a classification system developed by *Rosgen (1990)*. Channel types rated as "B" are typically in the 2- to 4-percent gradient range and have a moderate degree of meander (sinuosity). Channel-bed materials in B3 and B4 types are mainly cobble and gravel. Given the cobble and gravel beds, and the gradient of these stream types, bed materials commonly move. Gravel bars have formed on point bars in these reaches. No areas of down-cut channels were identified during field reconnaissance. Large woody debris was found in adequate supply to allow proper hydrologic function.

For further analysis of large woody debris, see *APPENDIX E -FISHERIES ANALYSIS*. Little evidence of past streamside harvesting was found, and, where past logging had taken place in the riparian area, the streams did not appear to be deficient in existing or potential downed woody material.

The existing road system leading to and in the proposed project area was reviewed for potential sources of sediment. The road system in the West Fork watershed is contributing an estimated 25.5 tons per year of sediment to streams. Roads proposed for hauling in the project area in the Johnson Creek watershed are contributing an estimated 5.2 tons of sediment per year to streams. These sediment-delivery values are estimates based on procedures outlined above and are not measured values.

Estimated sediment delivery occurs primarily at stream crossings and comes from a variety of sources. In the upper reaches of the West Fork in Stryker Basin, 3 existing crossings are constructed of wood and earth that are in various stages of decay; another structure is located on an unnamed tributary of West Fork. Combined, these structures are contributing an estimated 2.8 tons of sediment per year. In addition, each site is a high risk for failure due to decaying wood. In total, these 3 structures are comprised of approximately 760 tons of sediment, most of which, upon failure, would be delivered to the West Fork and Stryker Creek. Other sources of sediment delivery found during the inventory were a result of sites needing erosion-control devices installed on old roads that had been used before the adoption of forest management BMPs.

Much of the existing road system in the proposed project area meets applicable BMPs. Past project work has installed surface drainage on the road systems in Stryker and Herrig basins, as well as on the major routes in the West Fork watershed.

WATER YIELD

The allowable water-yield increase for the West Fork watershed has been set at 10 percent based on channel-stability evaluations, watershed sensitivity, and acceptable risk. This water-yield increase would be reached when the ECA level in the West Fork reaches the allowable level of 2,667. Timber harvesting and associated road construction activities have taken place in the West Fork watershed since the 1930s. These activities, combined with vegetative recovery, have led to an estimated 3.4 percent water-yield increase over an unharvested condition in the West Fork watershed. *TABLE C-1 - CURRENT WATER-YIELD AND ECA INCREASES IN THE WEST FORK* summarizes the existing conditions for water yield in the West Fork watershed.

TABLE C-1 - CURRENT WATER-YIELD AND ECA INCREASES IN THE WEST FORK

Percent WYI	3.4
Allowable WYI	10
Existing ECA	876
Allowable ECA	2,667
Remaining ECA	1,791

ALTERNATIVE EFFECTS

SEDIMENT DELIVERY

Direct and Indirect Effects

- ***Direct and Indirect Effects of No-Action Alternative A to Sediment Delivery***

  No-Action Alternative A would have no direct effects to sediment delivery beyond those currently occurring. Existing sources of sediment, both in-channel and out of channel, would continue to recover or degrade based on natural or preexisting conditions.

  The indirect effects would be an increased risk of sediment delivery to streams from crossings that do not meet applicable BMPs. These sites would continue to pose a risk of sediment delivery to streams until other funding became available to repair them.

- ***Direct and Indirect Effects Common to Both Action Alternatives***

  Each of the proposed action alternatives would replace the wooden West Fork bridge on Stryker Basin Road. Each of the action alternatives would also remove and rehabilitate 3 log and earth-fill crossings in the upper reaches of Stryker Basin.

  Replacement of the existing bridge over the West Fork would involve removal of log crib walls and the fill material that they are currently retaining. The existing structure is beginning to decay and, over time, would become an increasing risk of failure due to decay in the wood. A potential failure of the wood cribbing could allow several tons of sediment to enter the stream. The proposed new bridge would be designed to allow the stream to flow freely with no constriction of the bank-full channel. This would reduce the potential for bank erosion and channel down-cutting that may occur with vertical bridge abutments. The new crossing would also divert overland flow from the road surface away from the crossing site in both directions. This would lead to a decrease in delivery of approximately 0.11 tons of sediment per year at this site.

  Removal and rehabilitation of the 3 log/earth crossings in upper Stryker Basin would remove potential sources of sediment, as well as reduce current sediment delivery by approximately 2.22 tons per year for all 3 sites. As stated above, these 3 sites contain an estimated 750 tons of fill material. Removal and disposal of this material outside of the SMZ would remove the risk of this material being delivered to the West Fork and Swift Creek.

- ***Direct and Indirect Effects of Action Alternative B to Sediment Delivery***

  Several stream crossings would be replaced in the West Fork and Johnson Creek watersheds and along the proposed haul route. Erosion control and BMPs would be improved on approximately 31 miles of existing road. This work would decrease the estimated sediment load to the West Fork by approximately 4.2 tons of sediment per year, and reduce the estimated sediment load to Johnson Creek by approximately 2.7 tons per year. See *TABLE C-2 - SEDIMENT-DELIVERY*

TABLE C-2 - SEDIMENT-DELIVERY ESTIMATES IN THE WEST FORK

	West Fork			Johnson Creek		
	Alternative			Alternative		
	A	B	C	A	B	C
Postproject delivery (tons per year)	25.5	21.3	22.9	5.2	2.5	5.2
Reduction (tons per year)	0	4.2	2.6	0	2.7	0
Reduction percent	0	16%	10%	0	52%	0

ESTIMATES IN THE WEST FORK for a summary of sediment-delivery estimates.

Crossings proposed for replacement do not currently meet all applicable BMPs and require a new culvert or bridge in order to meet applicable standards. The replacement of existing stream crossings would contribute sediment directly to the West Fork. This sediment would be minimized through the application of standard erosion-control measures. The sediment delivery anticipated from this project would be short term and comply with all applicable permits and State water-quality laws. In addition, several sites would have additional erosion-control measures added to lower the risk of sediment delivery to a stream or draw. In some cases, the addition of erosion-control measures may increase the risk of sediment delivery in the short term by creating bare soil. However, as these sites revegetate, the long-term risk of sedimentation to a stream would be reduced to levels lower than the existing condition.

This alternative would also construct approximately 1.0 mile of new road to access proposed Harvest Area I, approximately 2.1 miles of temporary road in proposed Harvest Areas II-C, and 0.3 mile of new road to Harvest Area III-J. Reclamation of the temporary roads would occur immediately following completion of activities in the proposed harvest areas. The reclaimed road would present an increased risk of sediment delivery until bare soil revegetated.

Action Alternative B would have a very low risk of sediment delivery to streams as a result of the proposed timber-harvesting activities. Some harvesting activities may occur within designated SMZs. This harvesting activity would follow all requirements of the SMZ Law and have a low risk of affecting recruitment of large woody material to the West Fork, Johnson Creek, or their tributaries. The SMZ law, rules, and all applicable BMPs would be applied to all harvesting activities, which would minimize the risk of sediment delivery to draws and streams.

- ***Direct and Indirect Effects of Action Alternative C to Sediment Delivery***

  Several stream crossings would be replaced in the West Fork watershed and along the proposed haul route and erosion control and BMPs would be improved on approximately 25 miles of existing road. This work would decrease the estimated sediment load to the West Fork by approximately 2.6 tons of sediment per year.

  Crossings proposed for replacement do not currently meet all applicable BMPs; to meet applicable standards, a new culvert or bridge is required . The replacement of existing stream crossings would contribute sediment directly to the West Fork. This sediment would be minimized through application of standard erosion-control measures. The sediment delivery anticipated from this project would be short term and comply with all applicable permits and State water-quality laws. Also, additional erosion control would be added to several sites to lower the risk of sediment delivery to a stream or draw. In some cases, the addition of erosion-control measures may increase the risk of sediment delivery in the short term by creating bare soil. However, as these sites revegetate, the long-term risk of sedimentation to a stream would be reduced to levels lower than the existing condition.

This alternative would also construct approximately 1.0 mile of new road to access proposed Harvest Area I and approximately 2.1 miles of temporary road in Harvest Area II-C of the proposed project area. Reclamation of the temporary road would occur immediately following completion of activities in the proposed harvest areas. The reclaimed road would present an increased risk of sediment delivery until bare soil revegetated.

Action Alternative C would have a very low risk of sediment delivery to streams as a result of proposed timber harvesting activities. Some harvesting activities may occur within designated SMZs; these harvesting activities would follow all requirements of the SMZ Law, and would have a low risk of affecting recruitment of large woody material to the West Fork, Johnson Creek, or their tributaries. The SMZ law, rules, and all applicable BMPs would be applied to all harvesting activities, which would minimize the risk of sediment delivery to draws and streams. (See *TABLE C-2 - SEDIMENT-DELIVERY ESTIMATES IN THE WEST* FORK for a summary of sediment-delivery estimates.)

Cumulative Effects

- ***Cumulative Effects of No-Action Alternative A to Sediment Delivery***

  The cumulative effects of sediment delivery would be very similar to those described in the existing conditions portion of this analysis. All existing sources of sediment would continue to recover or degrade as dictated by natural and preexisting conditions until a source of funding became available to repair them. Sediment loads would remain at or near present levels.

- ***Cumulative Effects of Action Alternative B to Sediment Delivery***

  Cumulative effects to sediment delivery would be primarily related to roadwork, stream-crossing replacements, and rehabilitations. The sediment generated from the replacement of existing culverts would increase the total sediment load in the West Fork for the duration of activity. These increases would not exceed any State water-quality laws and would follow all applicable recommendations given in 124 and 318 permit applications. In the long term, the cumulative effects to sediment delivery would be a reduction from approximately 25.5 tons of sediment per year to 21.3 tons of sediment per year in the West Fork, and a reduction from approximately 5.2 tons per year to 2.5 tons per year in Johnson Creek. A summary of sediment-delivery estimates is found in *TABLE C-2 - SEDIMENT-DELIVERY ESTIMATES IN THE WEST FORK*. As the sites stabilize and revegetate, sediment levels resulting from culvert replacements would decrease further from projected levels as work sites and closed and reclaimed roads revegetate and stabilize. Over the long term, cumulative sediment loads would be reduced due to better designed crossings. Improved design would reduce the risk of structure failure, which would reduce the risk of sediment delivery to Swift Creek and other downstream waters.

  The installation and improvement of erosion-control and surface-drainage features on existing roads would also affect the cumulative sediment delivery to the West Fork and Johnson Creek, as described above. In the short term, the installation and improvement of surface-drainage features would expose bare soil. This would increase the risk of

sediment delivery to the streams in and around the proposed project area. The application of all applicable BMPs during this work would make increased sediment loads unlikely. Over the long term, with the installation of more effective surface-drainage and erosion-control features on the existing road system, cumulative sediment delivery to the West Fork and Johnson Creek is projected to be lower than existing conditions.

Harvesting trees within an SMZ would have a low risk of adverse cumulative effects to downed woody material in the West Fork watershed. The tree-retention requirements of the SMZ Law and the application of Forest Management Rules would ensure a future supply of woody material to the creeks.

None of the cumulative impacts described above are expected to adversely affect downstream beneficial uses. All activities would comply with applicable laws, rules, and regulations.

- ***Cumulative Effects of Action Alternative C to Sediment Delivery***

  Cumulative effects to sediment delivery would be primarily related to roadwork and stream-crossing replacements. The sediment generated from replacing existing culverts would increase the total sediment load in the West Fork for the duration of the activity. These increases would not exceed any State water-quality laws, and would follow all applicable recommendations given in the 124 and 318 permit applications. In the long term, the cumulative effects to sediment delivery would be a reduction from approximately 25.5 tons of sediment per year to approximately 22.9 tons of sediment per year in the West Fork. *TABLE C-2 - SEDIMENT-DELIVERY ESTIMATES IN THE WEST FORK* summarizes sediment-delivery estimates. As the sites stabilize and revegetate, sediment levels resulting from culvert replacements would decrease further from projected levels as work sites and closed and reclaimed roads revegetate and stabilize. Over the long term, cumulative sediment loads would be reduced due to a better crossing design. Improved design would reduce the risk of structure failure, which would reduce the risk of sediment delivery to Swift Creek and other downstream waters.

  The installation and improvement of erosion-control and surface-drainage features on existing roads would also affect the cumulative sediment delivery to the West Fork as described above. In the short term, the installation and improvement of surface drainage features would expose bare soil, which would increase the risk of sediment delivery to the streams in and around the proposed project area. The application of all applicable BMPs during this work would make increased sediment loads unlikely. Over the long term, with the installation of more effective surface drainage and erosion control features on the existing road system, cumulative sediment delivery to the West Fork is projected to be lower than existing conditions.

  Harvesting trees within an SMZ would have a low risk of adverse cumulative effects to downed woody material in the West Fork or its tributaries. The tree-retention requirements of the SMZ Law would ensure a future supply of woody material to the creeks.

  None of the cumulative impacts described above are expected to adversely affect downstream beneficial uses. All activities would comply with applicable laws, rules, and regulations.

WATER YIELD

Direct and Indirect Effects

- ***Direct and Indirect Effects of No-Action Alternative A to Water Yield***

  This alternative would have no direct or indirect effects on water yield. Water quantity would not be changed from present levels.

- ***Direct and Indirect Effects of Action Alternative B to Water Yield***

  The annual water yield in the West Fork watershed would increase by an estimated 2.6 percent over the current level; Johnson Creek would increase by 0.4 percent. These levels of water-yield increases would not be sufficient to create unstable channels.

- ***Direct and Indirect Effects of Action Alternative C to Water Yield***

  The annual water yield in the West Fork watershed would increase by an estimated 1.7 percent over the current level; Johnson Creek would increase by 0.2 percent. These levels of water-yield increases would not be sufficient to create unstable channels.

CUMULATIVE EFFECTS

- ***Cumulative Effects of No-Action Alternative A to Water Yield***

  This alternative would have no cumulative effects on water yield. Existing timber harvest units would continue to revegetate and move closer to premanagement levels of water use and snowpack distribution.

- ***Cumulative Effects of Action Alternative B to Water Yield***

  The removal of trees proposed in Action Alternative B would increase the water yield in the West Fork watershed from its current level of approximately 3.4 percent over unharvested to an estimated 6.0 percent. This water-yield increase and its associated ECA level includes the impacts of all past-management activity, existing and proposed roads, proposed timber harvesting, and vegetative hydrologic recovery in the West Fork watershed. The water-yield increase expected from Action Alternative B leaves the watershed well below the established threshold of concern. No impacts to water quality are expected as a result of this alternative. A summary of the anticipated water-yield impacts of Action Alternative B to the West Fork, Antice/Johnson watershed, and the entire Swift Creek drainage is found in *TABLE C-3 - WATER YIELD AND ECA INCREASES IN THE WEST FORK; TABLE C-4 - WATER YIELD AND ECA INCREASES IN ANTICE/JOHNSON WATERSHED;* and *TABLE C-5 - WATER YIELD AND ECA INCREASES IN THE SWIFT CREEK WATERSHED (INCLUDING WEST FORK AND ANTICE/JOHNSON)*.

- ***Cumulative Effects of Action Alternative C to Water Yield***

  The removal of trees would increase the water yield in the West Fork watershed from its current level of approximately 3.4 percent over unharvested to an estimated 5.1 percent. This water-yield increase and its associated ECA level includes the impacts of all past management activity, existing and proposed roads, proposed timber harvesting, and vegetative hydrologic recovery in the West Fork watershed. The water-yield increase expected from Action Alternative C leaves the watershed well below the established threshold of concern. No impacts to water quality are expected as a result of this alternative. A summary of the anticipated water-yield impacts of Action Alternative C to the West Fork, Antice/Johnson watershed, and the entire Swift Creek drainage is found in *TABLE C-3 - WATER-YIELD AND ECA INCREASES IN THE WEST FORK; TABLE C-4 - WATER-YIELD AND ECA INCREASES IN*

TABLE C-4 - WATER-YIELD AND ECA INCREASES IN THE ANTICE/JOHNSON WATERSHED

	ALTERNATIVE		
	A	B	C
Allowable WYI	10%	10%	10%
Percent WYI	3.5	3.9	3.7
Acres harvested	0	94	60
Miles of new road	0	0	0
ECA generated	0	91	57
Total ECA	641	732	698
Remaining ECA	1,181	1,090	1,124
Allowable ECA	1,822	1,822	1,822

TABLE C-5 - WATER-YIELD AND ECA INCREASES IN THE SWIFT CREEK WATERSHED (INCLUDING THE WEST FORK AND ANTICE/JOHNSON)

	ALTERNATIVE		
	A	B	C
Allowable WYI	10%	10%	10%
Percent WYI	3.4	4.2	3.9
Acres harvested	0	1,275	943
Miles of new road	0	1.0	0.7
ECA generated	0	1,204	879
Total ECA	4,833	6,040	5,714
Remaining ECA	7,529	6,322	6,648
Allowable ECA	12,362	12,362	12,362

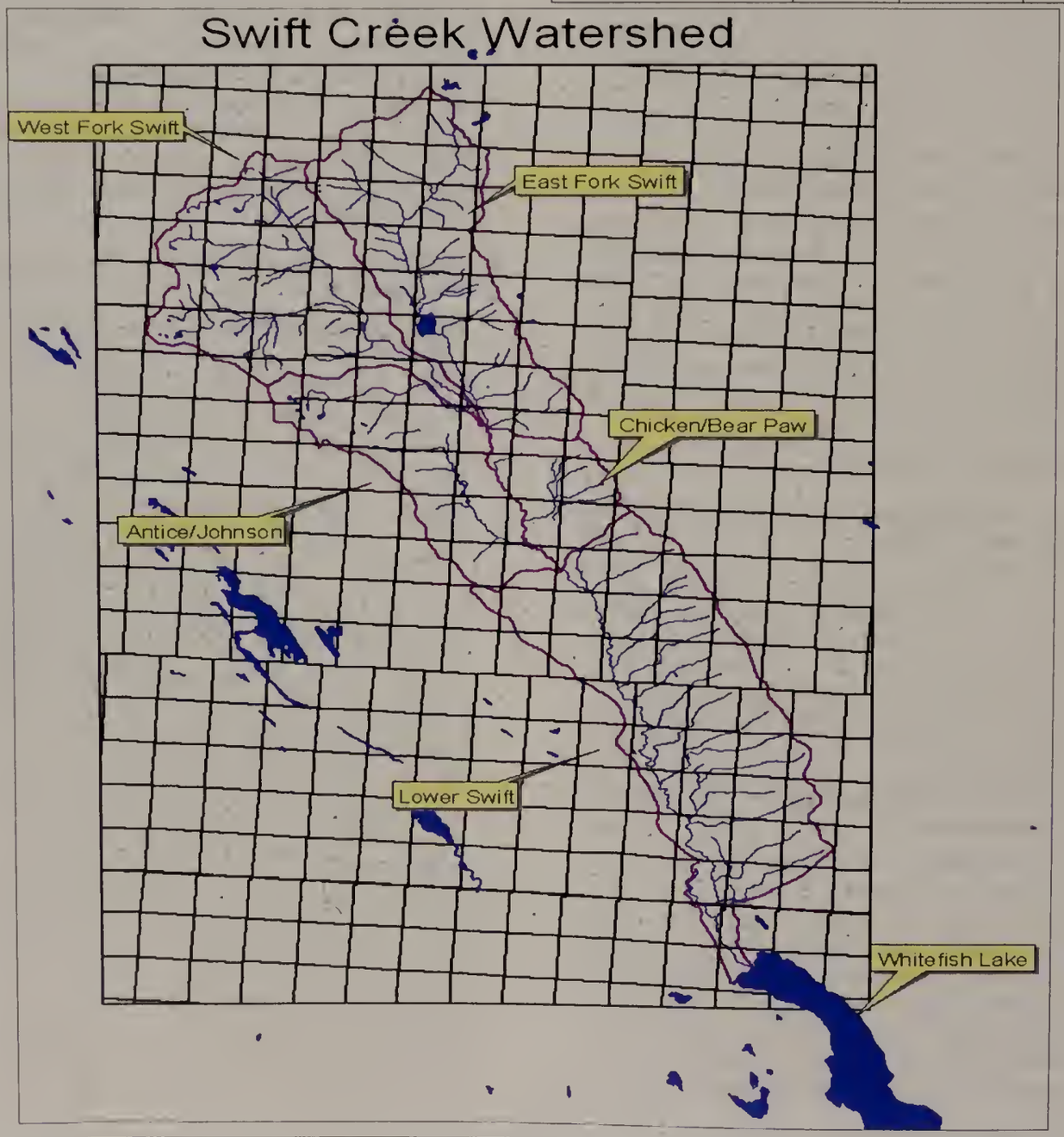
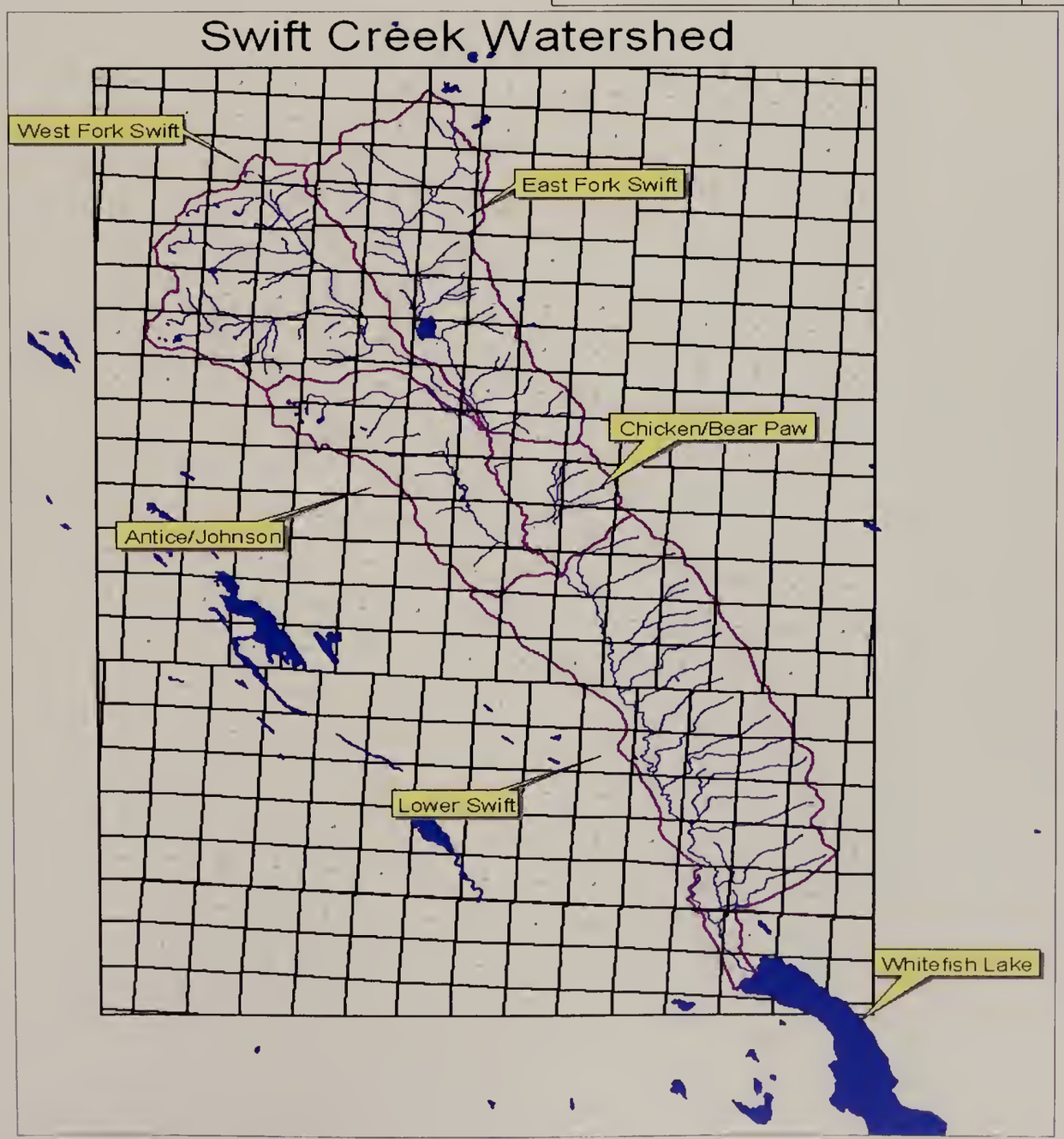


TABLE C-4 - WATER-YIELD AND ECA INCREASES IN THE ANTICE/JOHNSON WATERSHED

	ALTERNATIVE		
	A	B	C
Allowable WYI	10%	10%	10%
Percent WYI	3.5	3.9	3.7
Acres harvested	0	94	60
Miles of new road	0	0	0
ECA generated	0	91	57
Total ECA	641	732	698
Remaining ECA	1,181	1,090	1,124
Allowable ECA	1,822	1,822	1,822

TABLE C-5 - WATER-YIELD AND ECA INCREASES IN THE SWIFT CREEK WATERSHED (INCLUDING THE WEST FORK AND ANTICE/JOHNSON)

	ALTERNATIVE		
	A	B	C
Allowable WYI	10%	10%	10%
Percent WYI	3.4	4.2	3.9
Acres harvested	0	1,275	943
Miles of new road	0	1.0	0.7
ECA generated	0	1,204	879
Total ECA	4,833	6,040	5,714
Remaining ECA	7,529	6,322	6,648
Allowable ECA	12,362	12,362	12,362



Appendix D

Soils Analysis

APPENDIX D
SOILS ANALYSIS

INTRODUCTION

The Swift Creek watershed is a valley formed by glaciers and river processes. The dominant soil types found in the project area are deep glacial tills derived from argillite, siltite, and limestone from the Belt Supergroup. Upper slopes and ridges are weathered bedrock scoured by glaciers.

ANALYSIS METHODS

Soil productivity will be analyzed by evaluating the current levels of soil disturbance in the proposed project area. Analysis criteria will also include soil stability risk factors.

ANALYSIS AREA

The analysis area for evaluating soil productivity will include State-owned land within the West Fork Timber Sale Project area. The proposed project area is within both the West Fork and Antice/Johnson watersheds.

EXISTING CONDITION

In the West Fork watershed, DNRC has conducted timber harvesting since the 1940s. Since timber sale records dating back to the 1960s, 3,291 acres of State land have been harvested, using a combination of ground-based and cable-yarding harvest methods. Ground-based yarding can affect soil productivity through displacement and compaction of productive surface layers of soil, mainly on heavily used trails. Field review and aerial photos of the proposed project area show that much of the proposed project area has been harvested in the past. Field reconnaissance shows that many of the existing trails from past management are well vegetated and past impacts are ameliorating from frost and vegetation.

Soil types in the project area vary from nearly level wetland types along the West Fork to steep valley sideslopes on ridges. The Flathead National Forest Soil Survey identified one area of soils at high risk for mass movements in the project area. This soil type is landtype 74 and is found in the northern portion of the proposed project area. No slope failures were identified in the proposed project area during reconnaissance. A list of soil types found in the West Fork Timber Sale Project area and their associated management implications is found in *TABLE D-1—SUMMARY OF DIRECT EFFECTS OF ALTERNATIVES ON SOILS WITH SUMMER HARVESTING.*

ALTERNATIVE EFFECTS

DIRECT AND INDIRECT EFFECTS

- ***Direct and Indirect Effects of No-Action Alternative A on Soils***

  Soil productivity would not be directly or indirectly affected. No ground-based activity would take place, which would leave the soil in the project area unchanged from the description in the *EXISTING CONDITION* portion of this analysis.

- ***Direct and Indirect Effects of Action Alternative B on Soils***

  This alternative would have direct impacts on approximately 158 acres. Direct impacts would include compaction and displacement resulting from use of ground-based equipment to skid logs on approximately 937 acres, and used cable-yarding equipment on approximately 333 acres. Ground-based site preparation and road construction would also generate direct impacts to the soil resource. *TABLE D-1—SUMMARY*

OF DIRECT EFFECTS OF ALTERNATIVES ON SOILS WITH SUMMER HARVESTING summarizes the expected impacts to the soil resource as a result of Action Alternative B. These activities would leave up to 12 percent of the proposed harvest units in an impacted condition. DNRC expects to maintain long-term soil productivity based on the implementation of mitigation measures to control the area and degree of detrimental soil impacts to less than 15 percent of the proposed harvest area. A combination of skidding mitigation measures would include:

- restricting the season of use,
- utilizing a minimum skid-trail spacing,
- installing erosion control where needed,
- retaining woody debris, and
- following all applicable BMPs.

- ***Direct and Indirect Effects of Action Alternative C on Soils***

  Approximately 131 acres would be directly impacted. Direct impacts would include compaction and displacement resulting from use of ground-based equipment to skid logs on approximately 866 acres and cable-yarding equipment on approximately 72 acres. Ground-based site preparation and road construction would also generate direct impacts to the soil resource. *TABLE D-1—SUMMARY OF DIRECT EFFECTS OF ALTERNATIVES ON SOILS WITH SUMMER HARVESTING* summarizes the expected impacts to the soil resource as a result of Action Alternative C. These activities would leave up to 14 percent of the proposed harvest units in an impacted condition. DNRC expects to maintain long-term soil productivity based upon the implementation of mitigation measures to control the area and degree of detrimental soil impacts to less than 15 percent of the proposed harvest area. A combination of skidding mitigation measures would include:

  - restricting the season-of-use,
  - utilizing a minimum skid trail spacing,
  - installing erosion control where needed,
  - retaining woody debris, and
  - following all applicable BMPs.

CUMULATIVE EFFECTS

- ***Cumulative Effects of No-Action Alternative A to Soils***

  This alternative would have no cumulative impacts on soil productivity. No soil would be disturbed and no past harvest units would be reentered. Cumulative effects of this alternative would be similar to

TABLE D-1 – SUMMARY OF DIRECT EFFECTS OF ALTERNATIVES ON SOILS WITH SUMMER HARVESTING

DESCRIPTION OF PARAMETER	NO-ACTION ALTERNATIVE A	ACTION ALTERNATIVE B	ACTION ALTERNATIVE C
Acres of harvest	0	1,270	938
Acres of tractor yarding	0	937	866
Acres of skid trails and landings[1]	0	188	173
Acres of cable yarding	0	333	72
Acres of yarding corridors[2]	0	33	7
Acres of moderate impacts[3]	0	158	131
Percent of harvest area with impacts	0%	12.4%	14.0%

[1]20 percent of ground based area
[2]5 to 10 percent of cable yarding units
[3]75 percent of ground-based skid trails and 50 percent of cable corridors

those described under the *EXISTING CONDITION* portion of this analysis.

- ***Cumulative Effects Common to Action Alternatives B and C to Soils***

  Both action alternatives would enter several stands where previous timber management has occurred. Cumulative effects to soils may occur from repeated entries into a forest stand where additional ground is impacted by equipment operations. DNRC would maintain long-term soil productivity and minimize adverse cumulative effects by implementing any or all of the following:

  - If properly located and spaced, existing skid trails from past harvesting activities would be used.
  - Additional skid trails would be used only where existing trails are unacceptable.
  - The potential direct and indirect effects would be mitigated with soil moisture restrictions, season of operation, and methods of harvesting.
  - A portion of coarse woody debris and fine litter would be retained for nutrient cycling.

  In previously unharvested stands, cumulative effects to soil productivity from multiple entries would be the same as those listed in the direct and indirect effects sections.

West Fork Soil Types

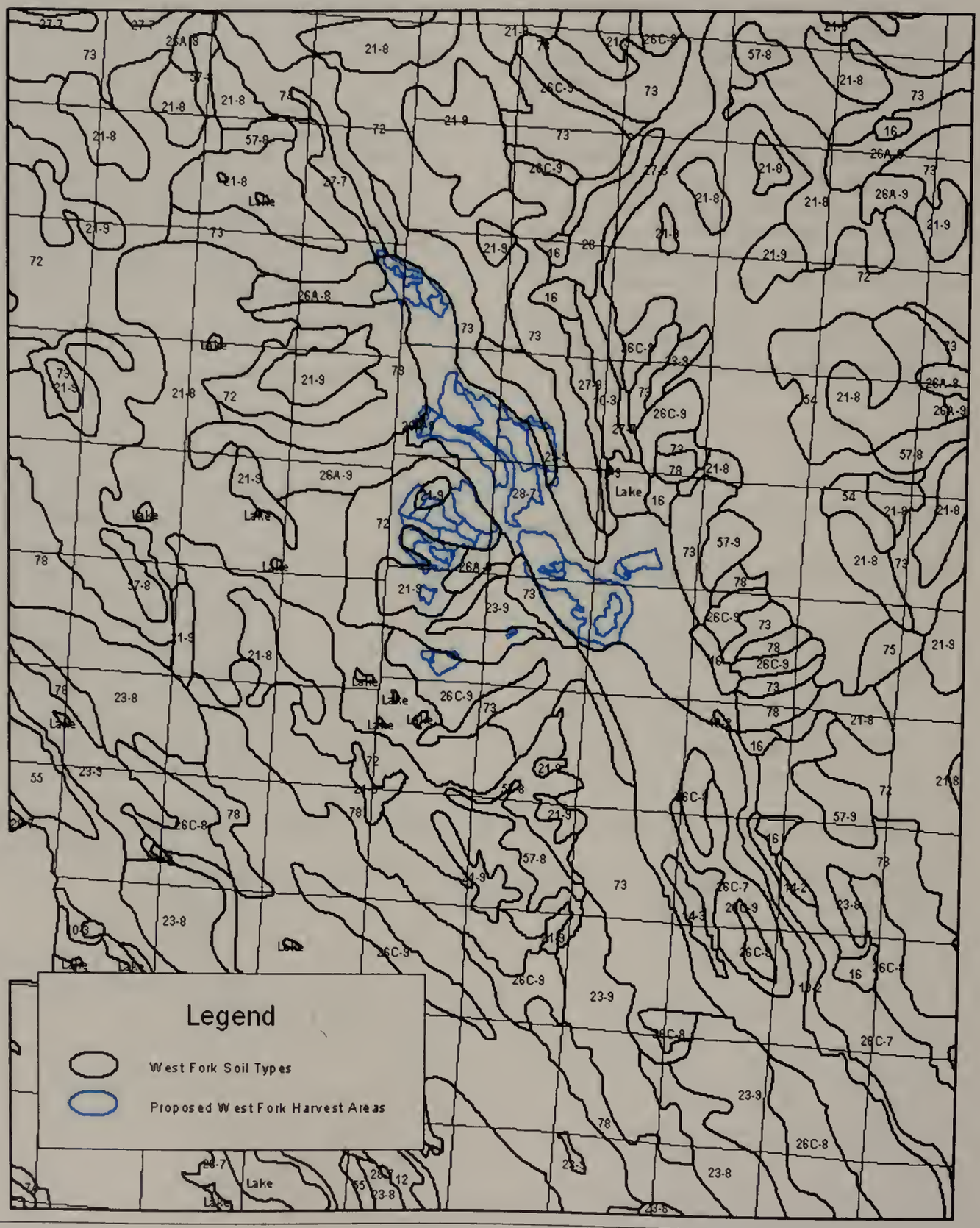


TABLE D-2 - SOIL MAP UNIT DESCRIPTIONS FOR THE WEST FORK TIMBER SALE PROJECT AREA

MAP UNIT	DESCRIPTION	SOIL DRAINAGE	ROAD LIMITATIONS	TOPSOIL DISPLACEMENT AND COMPACTION	SEEDLING ESTABLISHMENT	EROSION (BARE SURFACE)	NOTES
10-2	Alluvial soils	Poor to well drained	Moderate to severe	Severe	Good	Low	Streamside management guides will be applied.
14-3	Silty lacustrine terraces, 0-20% slopes	Somewhat poor	Poor bearing strength	Severe if wet	Good	High	Soil has very limited season of use; consider winter harvesting, designated skid trails. Roads may require turnpiking, special design, gravel. Lop and scatter slash, excavator pile, or broadcast burn.
21-8	Cirque basins, 20-40% slopes	Somewhat excessive	Moderate rock on ridges	Moderate	Fair, droughty	Moderate	Moderately deep coarse soils reduce water and nutrients. South slopes droughty. On slopes over 35%, lop and scatter slash, excavator pile, or broadcast burn.
21-9	Rock outcrops, shallow glacial till, 40-60% slopes	Moderate to well drained	Low/moderate	Moderate	Poor	Moderate	Unsurfaced roads are very bumpy due to shallow bedrock.
23-8	Glaciated mountain slopes, 20-40% slopes	Well drained	Low	Moderate/ high	Moderate competition	Moderate	Moderately deep coarse soils reduce water and nutrients. South slopes droughty. On slopes over 35%, lop and scatter slash, excavator pile, or broadcast burn.
23-9	Glaciated mountain slopes 40-60% slopes	Well drained	Low	Moderate/ high	Moderate competition	Moderate	Moderately deep coarse soils reduce water and nutrients. South slopes very droughty. Cable yard on slopes over 45% or soft-track up to 55% slopes.

MAP UNIT	DESCRIPTION	SOIL DRAINAGE	ROAD LIMITATIONS	TOPSOIL DISPLACEMENT AND COMPACTION	SEEDLLNG ESTABLISHMENT	EROSION (BARE SURFACE)	NOTES
26A-8	Glacial till, 20-40% slopes	Well drained	Moderate	Moderate	Good	Moderate	Deep productive soil. Fine-textured soil remains moist; check soil moisture. Topsoil depth is important.
26A-9	Glacial till, 20-40% slopes	Well drained	Moderate	Moderate	Good	Moderate	Deep productive soil. Fine-textured soil remains moist; check soil moisture. Topsoil depth is important.
26C-7	Glacial moraines, 0-20% slopes	Well drained	Low	Moderate (severe if wet)	Good	Low	Deep productive soil. Topsoil depth is important.
26C-8	Glacial moraines, 20-40% slopes	Well drained	Moderate/ high	Moderate/ high	Good	Moderate	Deep productive soil. Topsoil depth is important.
26C-9	Glacial moraines, 40-60% slopes	Well drained	Moderate/ high	Moderate/ high	Good	Moderate /high	Deep productive soil; average season of use. Limit soft-track skidder to slopes less than 45%.
27-7	Glacial dames and kettles, 10-20% slopes	Well drained	Low	Low	Fair	Moderate	Deep soil, low fertility. Topsoil depth is very important.
28-7	Glacial moraines, 0-20% slopes	Well drained	Low	Moderate	Moderate-droughty	Low	Topsoil depth is very important.
57-8	Residual soils, 20-40% slopes	Well drained	Low	Moderate	Fair, droughty	Moderate	Shallow and moderately deep very gravelly/rocky soils. Cable yarding on slopes over 45%, broadcast burn.

MAP UNIT	DESCRIPTION	SOIL DRAINAGE	ROAD LIMITATIONS	TOPSOIL DISPLACEMENT AND COMPACTION	SEEDLLNG ESTABLISHMENT	EROSION (BARE SURFACE)	NOTES
72	Glacial cirque wall, 60-90% slopes	Well drained	Rocky, steep	Low	Very poor	Low	Very shallow soils with excessively steep sideslopes. Cutslopes are difficult to revegetate.
73	Glacial trough wall, 60-90%	Well drained	Rocky, steep	Cable—moderate	Fair	High	Steep slopes, rocky soils with common rock outcrops. Cable logging recommended for slopes over 45%. Lop and scatter or excavator pile slash.
74	Stream breaklands, slopes over 60%	Fair to good, droughty on south slopes	Moderate to severe (steep)	High displacement	Fair, competition	High	Steep slopes require cable operation.

Appendix E
Fisheries Analysis

APPENDIX E
FISHERIES ANALYSIS

ISSUE

The purpose of this analysis is to assess potential impacts to cold-water fisheries within the West Fork Timber Sale Project area as a result of any one of the project alternatives.

INTRODUCTION

The West Fork Timber Sale Project area includes State trust lands within Sections 18, 19, 20, 28, 29, 30, 31, 32, 33, and 34, T34N, R23W, and Section 13, T34N, R24W, which lie entirely within the Swift Creek drainage (*5th code HUC 17010210050*). Up to 1,270 acres of total harvest area is proposed within the project area.

The project area includes the watersheds of 2 major tributaries of Swift Creek: West Fork of Swift Creek (West Fork) and East Fork of Swift Creek (East Fork). Additionally, 2 specific subbasins of the West Fork will be included in the analysis; from north to south, Stryker Creek and Johnson Creek. The downstream, main-stem reach of Swift Creek between Section 3, T33N, R23W, and Whitefish Lake is not within the project area and will not be included in this analysis. None of the project alternatives are expected to have any direct, indirect, or cumulative impacts with respect to downstream fisheries in the main-stem reach of Swift Creek.

The West Fork is identified on the Montana 303(d) list as an impaired stream, and a TMDL is scheduled for development in 2011. The portion of the West Fork within the project area has been identified as "not supporting" of cold-water fisheries and other aquatic life according to the 2002 and Draft 2004 303(d) lists developed by the DEQ. Probable causes of this listing include flow alteration, other habitat alterations, and siltation; the probable sources include silviculture and highway maintenance and runoff.

The East Fork is identified on the Montana 303(d) list, but is not scheduled for TMDL development as an impaired stream. The portion of the East Fork within the project area has been identified as "partially supporting" cold-water fisheries and other aquatic life according to the 2002 and draft 2004 303(d) lists developed by DEQ. Probable causes of this listing include flow alteration and other habitat alterations; the probable sources include silviculture, habitat modification (other than hydromodification), and modification/destablilization of banks or shoreline.

The Swift Creek drainage, including the West Fork, East Fork, and any contributing subbasins, is classified as A-1 in the Montana Surface Water Quality Standards. The A-1 classification is for multiple beneficial-use waters, including the growth and propagation of cold-water fisheries and associated aquatic life. Among other criteria for A-1 waters, a 1 degree Fahrenheit maximum increase above naturally occurring water temperature is allowed within the range of 32 to 66 degrees Fahrenheit (0 to 18.9 degrees Celsius) and no increases are allowed above naturally occurring concentrations of sediment, which will harm or prove detrimental to fish or wildlife. In regard to sediment, naturally occurring includes conditions or materials present from runoff on developed land where all reasonable land, soil, and water conservation practices have been

applied. Reasonable practices include methods, measures, or practices that protect present and reasonably anticipated beneficial uses. The State has adopted Forestry BMPs through its Nonpoint-Source Management Plan as the principle means of controlling nonpoint-source pollution from silvicultural activities (*Thomas et al 1990*).

SPECIES

Native cold-water fish species within the project area include bull trout (*Salvelinus confluentus*), westslope cutthroat trout (*Oncorhynchus clarki lewisi*), slimy sculpin (*Cottus cognatus*), largescale sucker (*Catostomus macrocheilus*), and longnose sucker (*Catostomus catostomus*). The 1 nonnative species known to persist within the specific project area is eastern brook trout (*Salvelinus fontinalis*).

Neither slimy sculpin, largescale sucker, nor longnose sucker are identified as endangered, threatened, or sensitive species (*Montana Natural Heritage Program [MNHP] 2003*). Although all 3 species are an integral component of the aquatic ecosystem within the project area, any foreseeable issues or concerns regarding these species' populations or habitats can be addressed through an effects analysis for bull trout and westslope cutthroat trout. Eastern brook trout is an invasive species that is not a component of the region's historical biodiversity, but any foreseeable issues or concerns regarding this species populations or habitats can also be addressed through an effects analysis for bull trout and westslope cutthroat trout.

Bull trout and westslope cutthroat trout are the primary cold-water species that will be addressed in this analysis. The U.S. Fish and Wildlife Service (USFWS) has listed bull trout as "threatened" under the Endangered Species Act. Both bull trout and westslope cutthroat trout are listed as Class-A Montana Animal Species of Concern. A Class-A designation is defined as a species or subspecies that has limited numbers and/or habitats both in Montana and elsewhere in North America and elimination from Montana would be a significant loss to the gene pool of the species or subspecies (DFWP, MNHP, and Montana Chapter American Fisheries Society Rankings). DNRC has also identified bull trout and westslope cutthroat trout as sensitive species (*ARM 36.11.436*).

Both bull trout and westslope cutthroat trout exhibit resident, fluvial, and adfluvial life forms. Resident life forms spend their juvenile and adult life in natal or nearby low-order tributaries. Fluvial and adfluvial life forms generally leave their natal streams within 1 to 3 years of emergence (*Shepard et al 1984, Fraley and Shepard 1989*) to mature in downstream river and lake systems, respectively, and then return again to headwater or upstream reaches to spawn. Fluvial and adfluvial life forms of bull trout and westslope cutthroat trout are typically larger than resident fish, and bull trout have been observed returning to upstream reaches during successive or alternating years to spawn (*Fraley and Shepard 1989*). The life forms and stages of bull trout and westslope cutthroat trout have evolved to coexist in overlapping geographic areas (*Nakano et al 1992, Pratt 1984, Shepard et al 1984*).

Fluvial and adfluvial bull trout generally mature between ages 5 to 6, begin upstream spawning migrations in April, and spawn between September and October in response to a temperature regime decline below 9 to 10 degrees Celsius (*Fraley and Shepard 1989*). Spawning adult bull trout are known to construct redds in close association with upwelling

groundwater and proximity to overhanging or instream cover (*Fraley and Shepard 1989*). Naturally occurring stream temperature regimes and substrate compositions having low levels of fine material are closely related to bull trout embryo and juvenile survival (*MBTSG 1998, Weaver and Fraley 1991, Pratt 1984*).

Resident westslope cutthroat trout have been observed maturing at ages 3 to 5 (*Downs et al 1997*), and all life forms are known to spawn during May through June (*Shepard et al 1984*). Naturally occurring stream-temperature regimes and substrate compositions having low levels of fine material are closely related to westslope cutthroat trout embryo and juvenile survival (*Pratt 1984*).

ISSUES RAISED DURING SCOPING

Four concerns were received by DNRC during the scoping process that pertain specifically to fisheries:

1) The project should protect the genetic diversity of existing bull trout populations.
2) The project should help protect bull trout and westslope cutthroat trout in Johnson and Swift creeks.
3) The project will not address existing areas of degraded habitat.
4) The project may further degrade bull trout habitat.

Concerns 1 and 2 are stated as conservation goals and are not considered "issues" to be described in the "Existing Conditions" and "Environmental Effects" sections. Concern 3 is an "issue" that will be addressed under the *Existing Conditions* habitat subissues for each basin and subbasin. Concern 4 is an "issue" that will be addressed under the *Alternative Effects* habitat subissues for each basin and subbasin.

ANALYSIS METHODS AND SUBISSUES

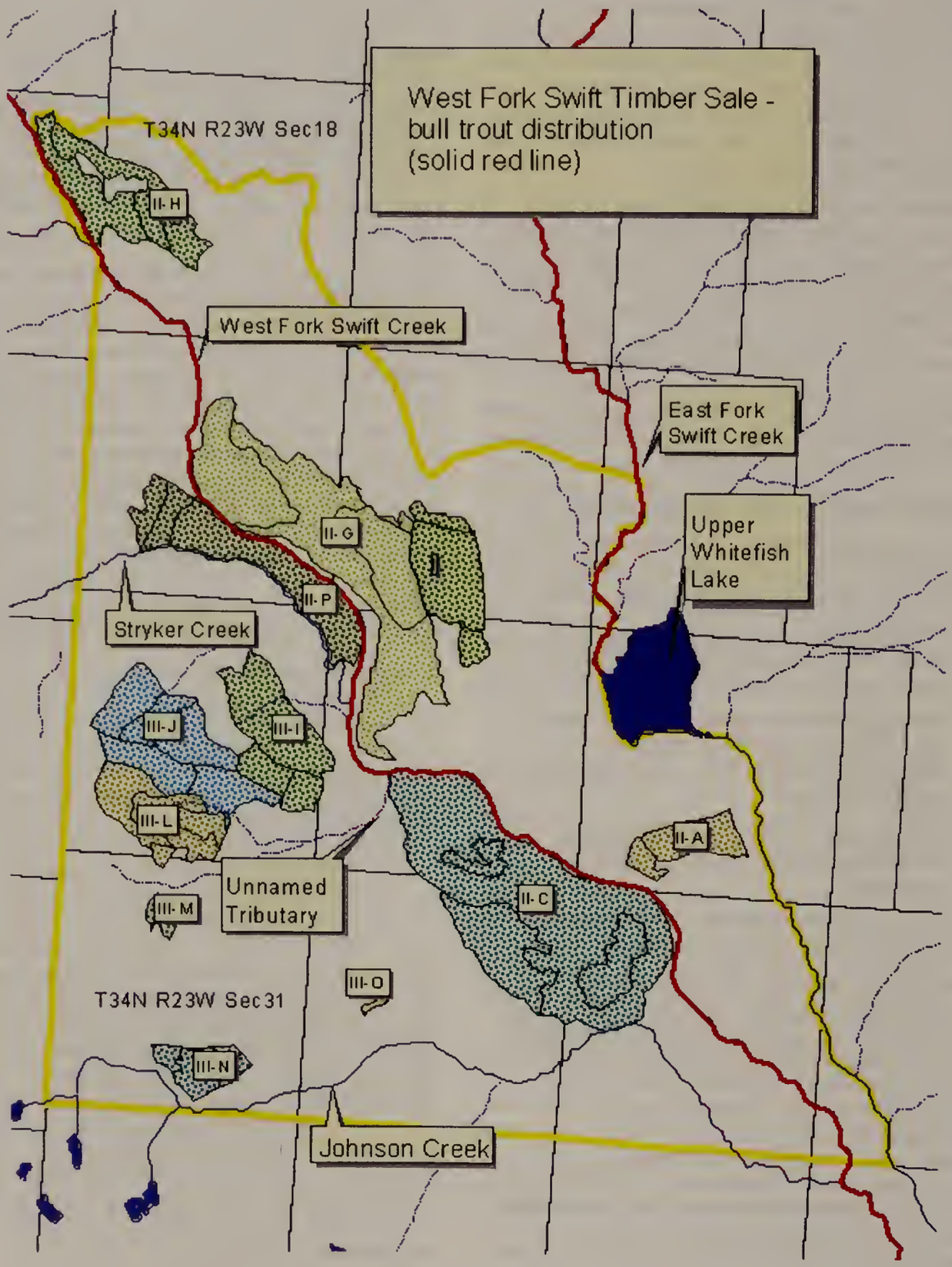
The existing conditions of bull trout and westslope cutthroat trout populations and habitat will be described in the *EXISTING CONDITIONS* portion of this analysis. In *ALTERNATIVE EFFECTS*, those existing conditions will then be compared to the anticipated effects of the project alternatives to determine foreseeable impacts to bull trout and westslope cutthroat trout.

Analysis methods are a function of the types and quality of data available for analysis, which varies among the different basins and subbasins in the project area. The analyses may either be quantitative or qualitative. The best available data for both populations and habitats will be presented separately for Stryker and Johnson creeks and the West Fork. Existing conditions and foreseeable environmental effects for each subbasin will be explored using the following outline of subissues:

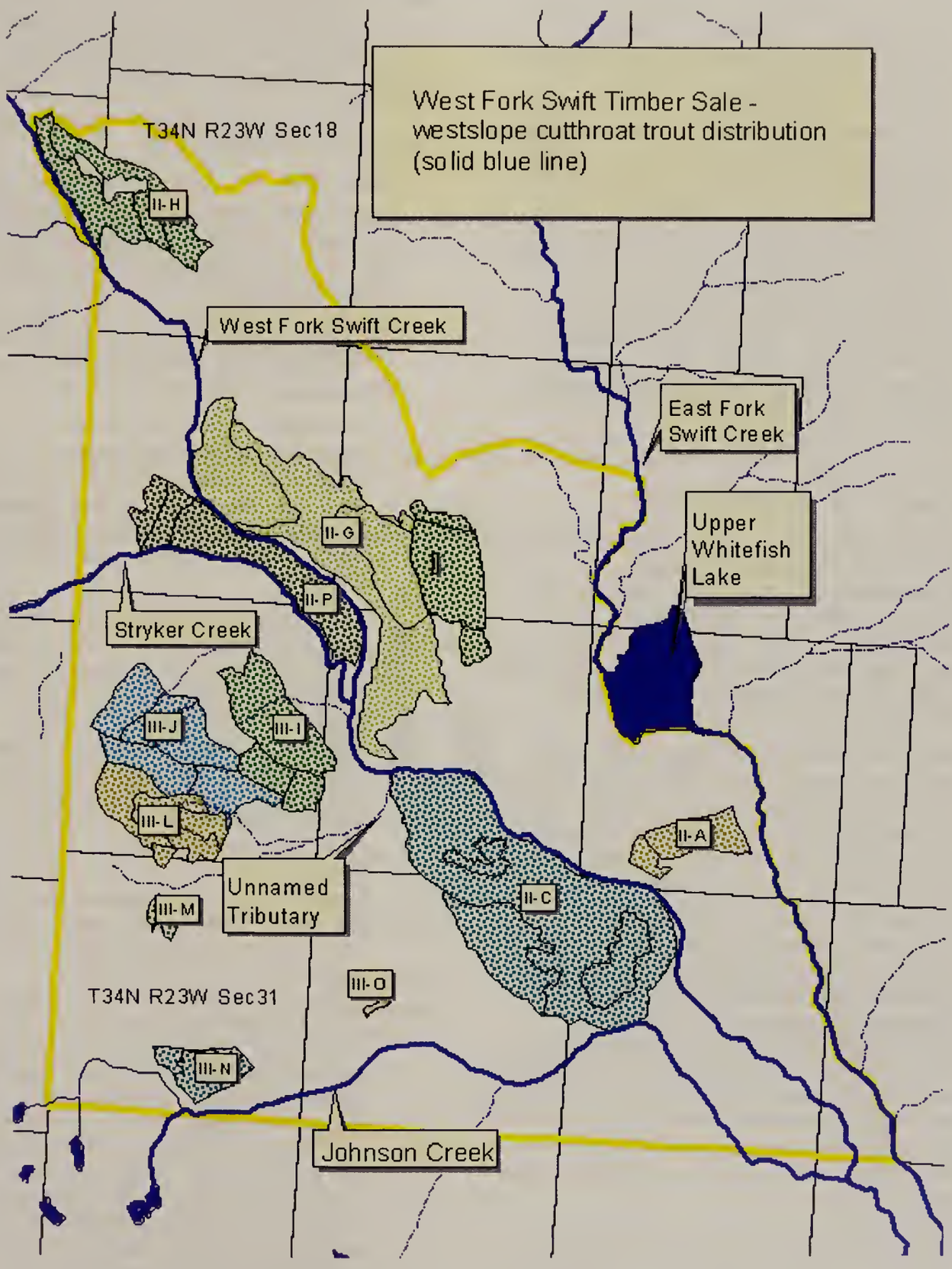
- Populations
  - Presence
  - genetics
- Habitat
  - flow regime
  - sediment
  - channel form
  - large woody debris
  - riparian zone
  - stream temperature
  - connectivity

The East Fork will not be analyzed for existing conditions under the *EXISTING CONDITIONS* or *ALTERNATIVE EFFECTS* sections since a portion of Harvest Area II-A (see Action Alternatives B and C below) is the only area within the East Fork watershed that is proposed for harvesting. This specific proposed harvest area includes approximately 31.5 acres within the East Fork watershed and lies on very low slope, 1 to 2 percent gradient terrain. The boundary of the proposed harvest unit parallels the

MAP 1 - KNOWN BULL TROUT DISTRIBUTION WITHIN THE PROJECT AREA (MFISH)



MAP 2 - *KNOWN WESTSLOPE CUTTHROAT TROUT DISTRIBUTION WITHIN THE PROJECT AREA (MFISH)*



East Fork for approximately 1,025 feet, but the boundary is at least 285 feet from the stream at all points. The very low relative amount of potential timber harvesting in the East Fork watershed and the associated risk of cumulative effects due to a potential water-yield increase is inconsequential (see *HYDROLOGY ANALYSIS*). Consequently, this stream will not be included in the fisheries analysis since no foreseeable direct, indirect, and/or cumulative impacts to bull trout or westslope cutthroat trout populations (presence genetics) or habitat (flow regime, sediment, channel form, large woody debris, riparian zone, stream temperature, connectivity) are expected as a result of No-Action Alternative A or Action Alternatives B or C.

SUMMARY OF ALTERNATIVES

See Chapter II in the Draft and Final Environmental Impact Statements of the West Fork Timber Sale Project for detailed information, specific mitigations, and road management plans pertaining to No-Action Alternative A and Action Alternatives B and C.

Under No-Action Alternative A, existing conditions relative to bull trout and westslope cutthroat trout in the project area would remain unchanged as a result of the selection of this alternative.

Action Alternative B involves 12 proposed timber harvest subareas in 3 areas; approximately 1,270 acres would be harvested using various silviculture plans. Actions associated with Action Alternative B would occur in the West Fork basin and the subbasins of Stryker Creek, and Johnson Creek, all of which provide varying degrees of bull trout and westslope cutthroat trout habitat.

Action Alternative C involves 6 proposed timber harvest subareas in 2 areas. Approximately 938 acres would be harvested using various silviculture plans. Actions associated with this alternative would occur in the West Fork basin and the subbasins of Stryker Creek, and Johnson Creek, all of which provide varying degrees of bull trout and westslope cutthroat trout habitat.

EXISTING CONDITIONS

➢ *WEST FORK*

The West Fork is a fourth-order stream; the entire reach within the project area is considered fish bearing.

West Fork Bull Trout and Westslope Cutthroat Trout Populations

- ***Presence***

  The West Fork has been identified as bull trout critical habitat as part of the Endangered Species Act (*USFWS 2002a*) and part of a disjunct bull trout population (*MBTSG 1995*).

  Although bull trout may exhibit the resident life form in the West Fork, this subbasin is likely used by bull trout primarily as spawning and rearing habitat for disjunct populations associated with Whitefish and Upper Whitefish lakes. Genetic data suggests that migratory adults in the upper Flathead River system have been found to frequently return to their natal or near-natal streams (*Kanda et al 1997*), and populations of migratory spawning adult fish in the Flathead River system have been observed returning to the same stream reaches during subsequent spawning runs (*Fraley and Shepard 1989*). This propensity for habitual adult migration to natal or near-natal streams and the consequent selection of unique spawning locations would make the use of redd counts in the West Fork a valid measure of the trends of the species'

overall success in occupying a specific subbasin.

The protocol for collecting redd count and estimated population data in the West Fork is described in *Weaver and Fraley (1991)*. Experienced crews and fixed survey boundaries are used for result consistency.

The data in *FIGURE D-1 - BULL TROUT REDD COUNTS IN WEST FORK OF SWIFT CREEK, 1994 THROUGH 2003* shows the number of bull trout redds constructed in the West Fork has ranged from 0 to 8 during the years 1994 to 2003. The data may also appear to describe a positive trend in bull trout success in the West Fork, but the statistical significance of the simple linear regression is very low (r^2 = 0.0515), and studies suggest that a larger data set is needed in order to begin identifying long-term trends in bull trout populations through redd counts (*Rieman and Myers 1997*). The data in *TABLE D-1 - BULL TROUT POPULATION ESTIMATES IN THE WEST FORK, 1995 THROUGH 2003* shows the population estimates of bull trout age 1 and older in the West Fork has ranged from 0.22 to 5.10 per 100 square meters during the years 1995 to 2003. The statistical significance of the simple linear regression for this data

FIGURE D-1 - BULL TROUT REDD COUNTS IN WEST FORK OF SWIFT CREEK, 1994 THROUGH 2003

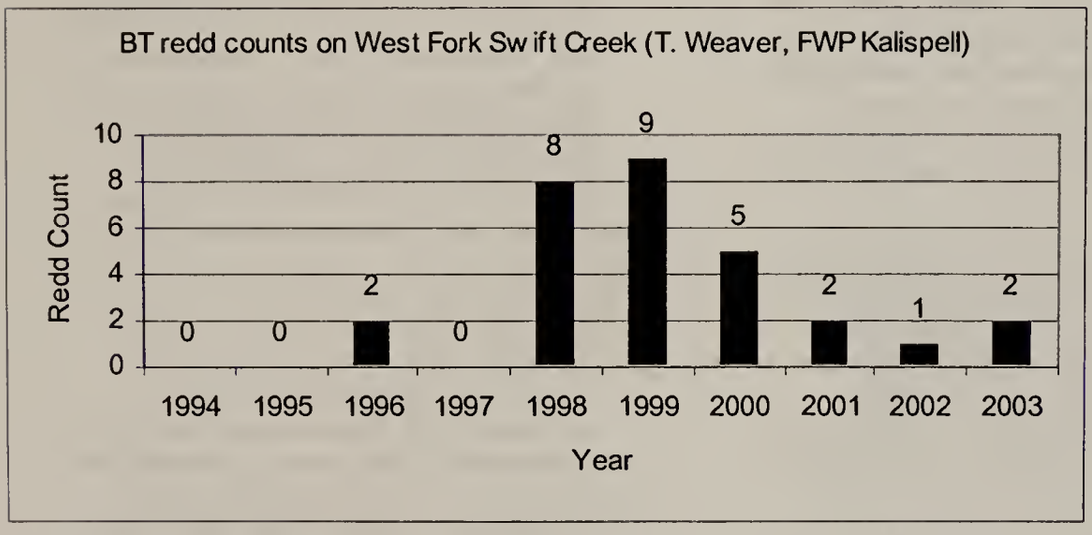


TABLE D-1 - BULL TROUT POPULATION ESTIMATES IN WEST FORK SWIFT CREEK, 1995 THROUGH 2003

DATE	POPULATION ESTIMATES	95-PERCENT CONFIDENCE INTERVAL	PROBABILITY OF FIRST-PASS CAPTURE	DENSITY (NUMBER PER 100 SQUARE METERS)
8/24/1995	9	no estimate		1.04
9/16/1996	7	no estimate		0.81
8/26/1997	8	no estimate		0.92
8/26/1998	44	+/-20	0.52	5.10
8/25/1999	14	+/-1	0.92	1.44
9/07/2000	9	+/-1	0.88	1.52
8/31/2001	29	+/-3	0.83	2.80
9/19/2002	12	+/-2	0.80	1.38
8/29/2003	2	no estimate		0.22

Data adapted from T. Weaver (fisheries biologist), DFWP, Kalispell: population estimates, 95-percent confidence intervals, probability of first-pass capture and densities for age 1 and older bull trout calculated from electrofishing in a 150-meter section of the West Fork.

set is also very low (r^2 = 0.0022). For these reasons, it is determined that insufficient data is available to infer existing bull trout population trends or long-term success in the West Fork.

The West Fork is used primarily as habitat for resident westslope cutthroat trout, although resident adults typically spawn in several of the stream's lower-order tributaries such as Herrig, Stryker, and Johnson creeks. The West Fork may also be utilized to some degree as spawning and rearing habitat for adfluvial life forms that have matured in Whitefish or Upper Whitefish lakes. DFWP has conducted surveys of westslope cutthroat trout redd counts during the 2000, 2001, and 2002 early summer seasons utilizing the same protocols as described above for bull trout. No westslope cutthroat trout redds were counted during those survey years.

Due to the lack of historic and comparable population presence data, there are no apparent existing direct and indirect impacts to bull trout and westslope cutthroat trout population presence in the West Fork.

- ***Genetics***

  Site-specific information from DFWP regarding bull trout genetics is unavailable. However, some level of hybridization has possibly occurred with resident or migratory eastern brook trout in the West Fork subbasin, as data suggests that this hybridization has occurred widely throughout the Flathead River basin (*Kanda et al 1997*). Any existing impact to bull trout populations in the subbasin as a result of hybridization with eastern brook trout most likely is low. Migratory bull trout tend to have a reproductive size advantage over resident eastern brook trout (*Reiman and McIntyre 1993*), and offspring can have a considerable chance of being sterile or exhibiting other progressive growth problems (*Leary et al 1983*).

  A DFWP genetic survey in 1984 of 26 westslope cutthroat trout collected from the West Fork found the subspecies slightly introgressed with rainbow trout. The genetic purity of westslope cutthroat trout was determined at that time to be 97.4 percent (*MFISH 2004*).

  Due to the possibility of bull trout and brook trout hybridization and the known occurrence of introgressed westslope cutthroat trout, there are existing low to moderate direct and indirect impacts to bull trout and westslope cutthroat trout population genetics in the West Fork.

West Fork Bull Trout and Westslope Cutthroat Trout Habitat

- ***Flow Regime***

  Flow regime is the range of discharge frequencies and intensities in a specific watershed that occur throughout the year. The analysis of hydrologic data for the West Fork basin indicates that the existing average flow regime for the stream is approximately 3.4 percent above the range of naturally occurring conditions (see *APPENDIX C - WATERSHED AND HYDROLOGY ANALYSIS*), which is primarily a result of past forest crown removal. The range of naturally occurring conditions is considered representative of those flow regimes in a fully forested, mature (20 to 30 years old) watershed.

Changes in flow regime can affect bull trout and westslope cutthroat trout through modifications of stream morphology, sediment budget, streambank stability, and channel formations. There is likely no detectable existing impact on these specific habitat characteristics as a result of the estimated 3.4 percent increase in flow regime.

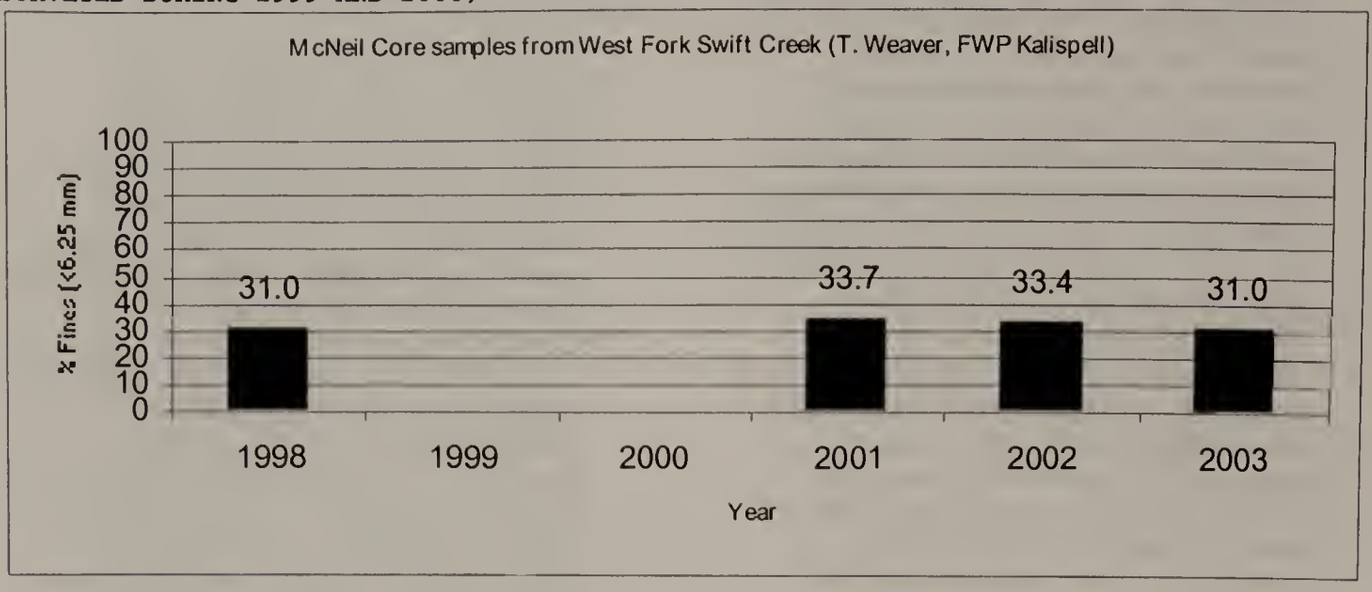
Changes in flow regime have been known to affect bull trout and westslope cutthroat trout spawning migration, habitat available for spawning, and embryo survival; for this reason, there is a very low potential for direct and indirect impacts to bull trout and westslope cutthroat trout as a result of flow-regime modifications in the West Fork.

- ***Sediment***

  Existing stream-sediment processes that are described in this Fisheries Analysis are *Rosgen* stream-morphological type, sediment budget, and streambank stability. The stream morphology of the West Fork, from the confluence with the East Fork (river mile 0.00) in Section 3, T33N, R23W, upstream through the project area and to a point (river mile 7.13) in Section 12, T34N, R24W, is generally described as exhibiting a B3/B4 *Rosgen* morphological type with gradients ranging from 2 to 4 percent (*Koopal 2001*). The B morphological type broadly includes riffle-dominated streams in narrow, gently sloping valleys, which typically exhibit infrequently spaced pools (*Rosgen 1996*). Furthermore, the B3/B4 morphological type is characteristic of channel compositions dominated by cobbles and codominated by gravels, with lesser amounts of boulder, gravel, and sand (*Rosgen 1996*).

  Several surveys have been conducted to describe the sediment budget of the West Fork, including McNeil core, substrate score, and Wolman pebble count. The McNeil core sampling methodology (*McNeil and Ahnell 1964*) has been demonstrated to be an effective technique for measuring temporal changes in the streambed permeability of spawning gravels. McNeil core data has been collected at known bull trout spawning reaches in the West Fork between 1998 and 2003 (*FIGURE D-2 - MCNEIL CORE SAMPLES FROM THE WEST FORK, 1998 THROUGH 2003 [NOT SURVEYED DURING 1999 AND 2000]*). *Weaver and Fraley (1991)* found that the percentage of substrates less than 6.35 millimeter in spawning beds was inversely proportional to bull trout and westslope cutthroat trout embryo survival in the Flathead River basin. The Flathead Basin Commission, a cooperative program involving private, State, and Federal landowners in the river basin, subsequently determined that streams with spawning gravels having 35 or 40 percent of substrates less than 6.35 millimeter in any given year were "threatened" or "impaired", respectively, in regards to bull trout and western cutthroat trout embryo survival (*Flathead Basin Commission 1991*). The McNeil core sample results from the West Fork are collected using *Weaver and Fraley (1991)* and displayed in *FIGURE D-2 - MCNEIL CORE SAMPLES FROM THE WEST FORK, 1998 THROUGH 2003 [NOT SURVEYED DURING 1999 AND 2000]*) to show the proportion of substrates in the less than 6.35 millimeter size class. All of the sample sets show that the

FIGURE D-2 - MCNEIL CORE SAMPLES FROM THE WEST FORK, 1998 THROUGH 2003 (NOT SURVEYED DURING 1999 AND 2000)



proportion of substrates less than 6.35 millimeters is under the 35 percent threshold for "threatened" status.

Embeddedness is generally described as the degree to which fine sediments surround coarse substrates on the streambed surface (*Sylte and Fischenich 2002*). The substrate score is one technique for measuring embeddedness, where higher scores indicate lower embeddedness and typically better juvenile bull trout habitat (*Shepard et al 1984*). A modified substrate score methodology has been employed on the West Fork (*Weaver and Fraley 1991 citing others*) from 1994 through 2003 (see *FIGURE D-3 - SUBSTRATE SCORE SAMPLES FROM THE WEST FORK, 1994 THROUGH 2003 [NOT SURVEYED DURING 1995 AND 1998]*). The Flathead Basin Commission has subsequently determined that streams with substrate scores of 10 or 9 in any given year were "threatened" or "impaired", respectively, in regards to bull trout and westslope cutthroat trout embryo survival and juvenile rearing habitat (*Flathead Basin Commission 1991*). All of the sample sets in *FIGURE D-3 - SUBSTRATE SCORE SAMPLES FROM WEST FORK SWIFT CREEK, 1994 THROUGH 2003 (NOT SURVEYED DURING 1995 AND 1998)* show substrate scores higher than 10, and the data also suggests that overall habitat quality as it relates to substrate embeddedness is likely improving over time.

The Wolman pebble count (*Wolman 1954*) is another method that can be used to describe temporal changes in substrate size classes on the streambed surface. Sample data from 2 collection sites on the West Fork is only available for the year 2001 (*FIGURE D-4 - WOLMAN PEBBLE COUNT RESULTS FROM THE WEST FORK, 2001*). The combined percentage of substrates less than 8 millimeter is 7.5 percent, which is considerably lower than the results calculated for the similar size class in the McNeil core samples (percentage of substrate less than 6.35 millimeters ranges from 31.0 to 33.7 percent). This difference suggests that there could be a greater level of interstitial spaces in the streambed surface gravel and

FIGURE D-3 - SUBSTRATE SCORE SAMPLES FROM WEST FORK SWIFT CREEK, 1994 THROUGH 2003 (NOT SURVEYED DURING 1995 AND 1998)

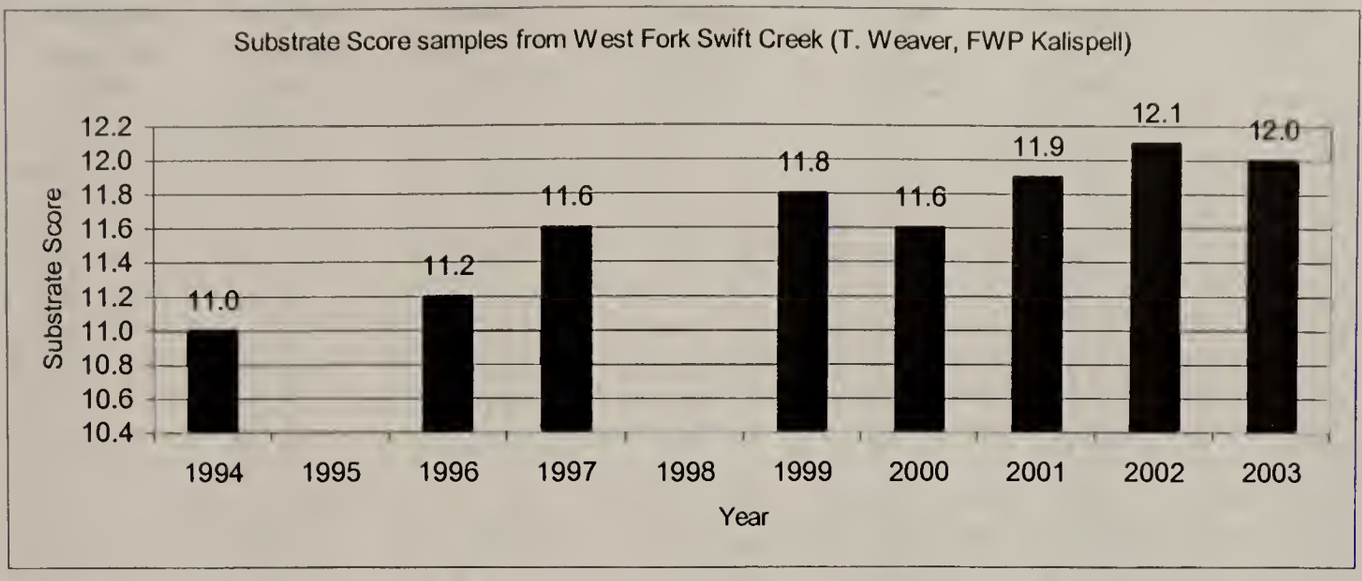
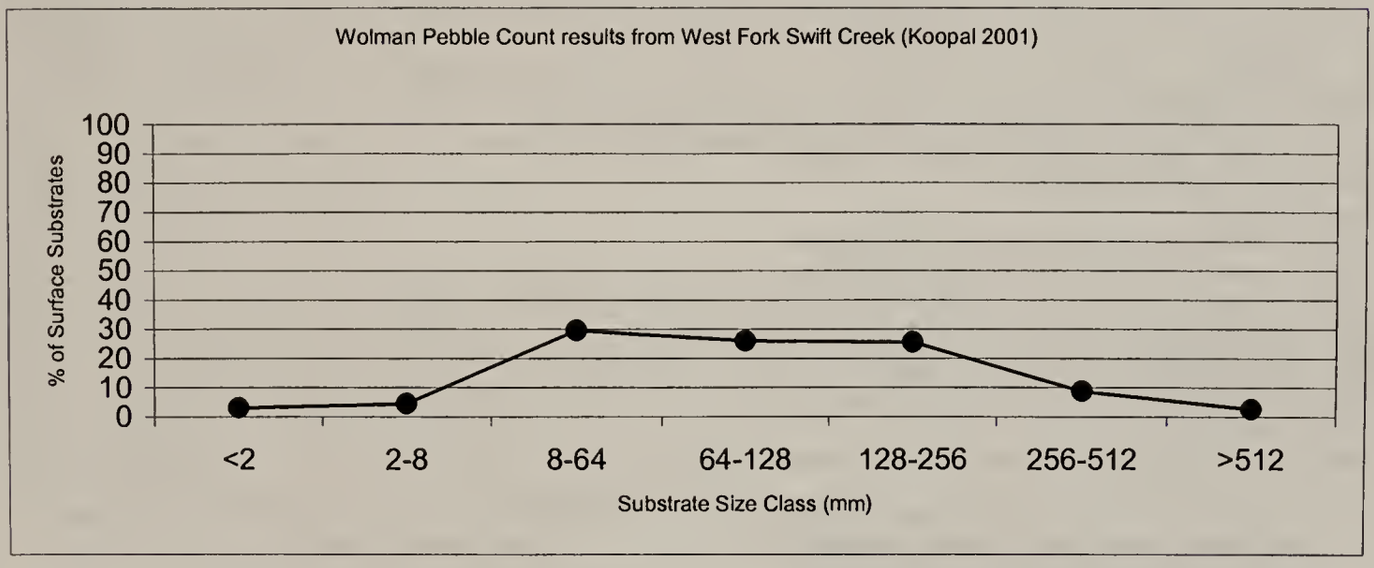


FIGURE D-4 - WOLMAN PEBBLE COUNT RESULTS FROM THE WEST FORK, 2001



cobble substrates than may be indicated by the McNeil core data.

The final assessment of stream sediment processes includes a description of existing streambank stability. Streambank stability is a measure of bank erosion rates per stream length; temporal changes in the rates can be used as one indicator of potential existing impacts to fish habitats. Streambank stability data for the West Fork is only available for the year 2001 (*TABLE D-2 - STREAMBANK STABILITY RESULTS FROM THE WEST FORK (KOOPAL 2001)*) and includes all stream habitats from the confluence with the East Fork (river mile 0.00) in Section 3, T33N, R23W, upstream through the project area and to a point (river mile 7.13) in Section 12, T34N, R24W. The protocol used for collecting the streambank stability data is outlined in *Overton et al (1997)*. Overall, the results of this data set show very high levels (99.19 percent) of streambank stability throughout the project area.

McNeil core data indicates that

TABLE D-2 - STREAMBANK STABILITY RESULTS FROM THE WEST FORK (KOOPAL 2001)

HABITAT TYPE*	TOTAL NUMBER OF UNITS	TOTAL LEFT BANK LENGTH (FEET)	TOTAL RIGHT BANK LENGTH (FEET)	MEAN PERCENT STABLE BANK	MEAN PERCENT UNSTABLE BANK	MEAN PERCENT UNDERCUT BANK
DMV	1	49.0	49.0	100.00	0.00	15.00
DMW	5	215.0	214.0	86.60	13.40	0.70
GLD	2	220.0	220.0	100.00	0.00	0.00
HGR	7	831.0	832.0	100.00	0.00	0.26
LGR	140	29,135.0	29,303.0	99.26	0.74	1.09
RUN	27	2,714.0	2,704.0	100.00	0.00	2.09
SLB	6	178.0	178.0	100.00	0.00	2.30
SLM	27	999.0	1,003.0	100.00	0.00	7.09
SLW	22	595.0	591.0	94.18	5.82	2.76
SMB	12	476.0	486.0	100.00	0.00	2.35
SMW	10	324.0	329.0	99.17	0.83	6.26
SPB	2	71.0	75.0	100.00	0.00	3.08
SPW	38	1,016.0	1,011.0	97.83	2.17	5.01
STP	4	315.0	304.0	100.00	0.00	0.00
SUW	12	402.0	408.0	99.36	0.64	10.80
Totals	315	37,540.0	37,707.0			
Mean				99.19	0.81	1.61

**DMV = main channel dammed pool caused by beaver*
DMW = main channel dammed pool caused by large woody debris
GLD = glide, "HGR" = high gradient riffle
LGR = low gradient riffle
RUN = run
SLB = lateral scour pool formed by boulder
SLM = lateral scour pool formed by meander
SLW = lateral scour pool formed by large woody debris
SMB = mid-channel scour pool formed by boulder
SMW = mid-channel scour pool formed by large woody debris
SPB = plunge pool formed by boulder
SPW = plunge pool formed by large woody debris
STP = step-pool
SUW = underscour pool formed by large woody debris

the substrates of known spawning reaches are not "threatened"; substrate scores describing streambed substrate embeddedness also indicate that known spawning reaches are not "threatened", and Wolman pebble counts suggest that there are high levels of streambed substrates in the gravel, cobble, and boulder classes. Additionally, a recent streambank-stability assessment shows very low levels of potential streambank erosion. Based on these observations, there are no existing direct and indirect impacts to bull trout and westslope cutthroat trout habitat as a result of sediment in the West Fork.

- ***Channel Forms***

  Two descriptions of channel formation will also be used to describe existing bull trout and westslope cutthroat trout habitat in the West Fork: *Montgomery/Buffington* classification (*Montgomery and Buffington 1997*) and *R1/R4 Fish Habitat Standard Inventory* (*Overton et al 1997*). The stream formations of the West Fork, from the confluence with the East Fork (river mile 0.00) in Section 3, T33N, R23W, upstream through the project area and to a point (river mile

TABLE D-3 - R1/R4 FISH HABITAT STANDARD INVENTORY RESULTS FROM THE WEST FORK SWIFT CREEK (KOOPAL 2001)

HABITAT TYPE*	TOTAL NUMBER OF UNITS	MEAN HABITAT LENGTH (FEET)	MEAN WIDTH (FEET)	MEAN HABITAT DEPTH (FEET)	MEAN WIDTH/DEPTH RATIO	MEAN HABITAT AREA (SQUARE FEET)	MEAN HABITAT VOLUME (CUBIC FEET)
DMV	1	49.0	19.5	0.68	28.68	955.5	649.7
DMW	5	41.4	18.7	0.76	24.90	772.2	586.0
GLD	2	110.0	13.7	0.52	32.55	1,509.0	777.6
HGR	7	118.4	14.1	0.54	27.91	1,669.2	894.5
LGR	140	208.0	17.2	0.52	35.94	3,568.7	1,873.5
RUN	27	107.5	17.1	0.65	29.37	1,838.0	1,194.2
SLB	6	29.3	16.4	0.79	20.91	479.7	377.8
SLM	27	36.5	16.0	0.83	21.07	584.7	483.6
SLW	22	26.0	17.9	0.84	24.45	465.6	393.3
SMB	12	39.6	17.8	0.77	24.17	702.6	539.0
SMW	10	31.8	19.5	0.72	29.70	620.6	447.4
SPB	2	35.5	12.6	0.76	16.62	446.8	340.2
SPW	38	26.1	18.1	0.89	22.56	471.8	418.6
STP	4	75.3	19.2	1.01	19.71	1,446.1	1,455.7
SUW	12	33.1	20.3	0.86	25.26	671.0	575.1
Total	315						
Mean		119.4	17.1	0.57	33.70	2,047.5	1,175.1

**DMV = main channel dammed pool caused by beaver*
DMW = main channel dammed pool caused by large woody debris
GLD = glide
HGR = high gradient riffle
LGR = low gradient riffle
RUN = run
SLB = lateral scour pool formed by boulder
SLM = lateral scour pool formed by meander
SLW = lateral scour pool formed by large woody debris
SMB = mid-channel scour pool formed by boulder
SMW = mid-channel scour pool formed by large woody debris
SPB = plunge pool formed by boulder
SPW = plunge pool formed by large woody debris
STP = step-pool
SUW = underscour pool formed by large woody debris

7.13) in Section 12, T34N, R24W, are broadly described as exhibiting both 'pool-riffle' and 'forced pool-riffle' Montgomery/Buffington classifications. The 'forced pool-riffle' channel form is generally a function of large-woody-debris recruitment to the bankfull area of the stream, and both channel forms typically have pool frequencies of 1:5 to 1:7, where the later ratio is channel width (*Montgomery and Buffington 1997*).

The *R1/R4 Fish Habitat Standard Inventory* is a useful protocol for describing existing conditions and tracking temporal changes in the relative proportions of different stream microhabitats used by bull trout, westslope cutthroat trout, and other native fisheries. Inventory data for the West Fork is only available for the year 2001 (*TABLE D-3 - R1/R4 FISH HABITAT STANDARD INVENTORY RESULTS FROM THE WEST FORK (KOOPAL 2001*) and includes all stream habitats from the confluence with the East Fork (river mile 0.00) in Section 3, T33N, R23W, upstream through the

project area and to a point (river mile 7.13) in Section 12, T34N, R24W.

The *R1/R4 Fish Habitat Standard Inventory* data from 2001 indicates that 56 percent of all channel forms are nonpool features (GLD, HGR, LGR, RUN), and the remaining 44 percent of all channel forms are pool features. The relative numbers of nonpool and pool channel forms are roughly equivalent to the mean quantity of habitat area, which is 53 and 47 percent, respectively. On the contrary, the mean quantity of habitat volume in the West Fork is 43 percent for nonpool features and 57 percent for pool features. Increasing amounts of different pool habitats are typically proportional to increasing levels of bull trout and westslope cutthroat trout stream-habitat quality. As B morphological type streams are generally riffle dominated (*Rosgen 1996*), this data indicates that the West Fork likely provides an average quantity of pool habitat within the project area.

No specific conclusions regarding trends in channel form can be drawn from these current observations, but this data will be indispensable in future habitat assessment and monitoring efforts. Although insufficient data is available for describing existing trends in channel forms, likely there are no existing direct and indirect impacts to bull trout and westslope cutthroat trout habitat as a result of channel formations in the West Fork.

- ***Large Woody Debris***

  Large woody debris is recruited to the stream channel from adjacent and upstream riparian vegetation, and the material is a critical component in the formation of complex bull trout and westslope cutthroat trout habitat. All life stages of bull trout and westslope cutthroat trout have been observed closely associated with large woody debris in the Flathead River basin (*Platt 1984, Shepard et al 1984*). Large woody debris recruitment rates to the West Fork throughout the project area can be described using large-woody-debris counts per stream length; this data was collected during 2001 as part a *R1/R4 Fish Habitat Standard Inventory* (*Overton et al 1997*). (See *TABLE D-4 - LARGE-WOODY-DEBRIS COUNT RESULTS FROM THE WEST FORK [KOOPAL 2001]*). Large-woody-debris counts for the West Fork include all stream habitats from the confluence with the East Fork (river mile 0.00) in Section 3, T33N, R23W, upstream through the project area and to a point (river mile 7.13) in Section 12, T34N, R24W.

  The mean large-woody-debris count per 1,000 feet is calculated by dividing the sum of the total number of single pieces, the number of pieces in each aggregate, and the total number of root wads by the total length of all main-channel habitat units (37,612.0 feet) surveyed during the inventory. The mean large-woody-debris count per 1,000 feet in the West Fork is 50 pieces per 1,000 feet.

  Data from reference reaches (*Harrelson et al 1994*) in the Flathead River Basin region indicate that the average amount of large woody debris in undisturbed 'B' channel types (*Rosgen* morphological stream type) is 123 pieces per 1,000 feet plus or minus 57 percent (*Bower 2004*). This data suggests that existing amounts of large woody debris in the

TABLE D-4 - LARGE-WOODY-DEBRIS COUNT RESULTS FROM THE WEST FORK (KOOPAL 2001)

HABITAT TYPE*	TOTAL NUMBER OF UNITS	SINGLE PIECES			AGGREGATES				ROOT WADS		
		TOTAL NUMBER	MEAN NUMBER	NUMBER PER 100 FEET	TOTAL NUMBER	MEAN NUMBER	NUMBER PER 100 FEET	NUMBER OF PIECES	TOTAL NUMBER	MEAN NUMBER	NUMBER PER 100 FEET
DMV	1	1	1.0	2.0	0	0.0	0.0	0	0	0.0	0.0
DMW	5	1	0.2	0.5	6	1.2	2.9	47	0	0.0	0.0
GLD	2	2	1.0	0.9	0	0.0	0.0	0	0	0.0	0.0
HGR	7	12	1.7	1.4	6	0.9	0.7	16	0	0.0	0.0
LGR	140	368	2.6	1.3	223	1.6	0.8	707	14	0.1	0.0
RUN	27	33	1.2	1.1	25	0.9	0.9	77	1	0.0	0.0
SLB	6	5	0.8	2.8	2	0.3	1.1	10	0	0.0	0.0
SLM	27	24	0.9	2.4	10	0.4	1.0	41	6	0.2	0.6
SLW	22	3	0.1	0.5	20	0.9	3.5	94	2	0.1	0.3
SMB	12	11	0.9	2.3	8	0.7	1.7	32	1	0.1	0.2
SMW	10	2	0.2	0.6	10	1.0	3.1	59	1	0.1	0.3
SPB	2	2	1.0	2.8	2	1.0	2.8	7	0	0.0	0.0
SPW	38	23	0.6	2.3	29	0.8	2.9	161	0	0.0	0.0
STP	4	3	0.8	1.0	5	1.3	1.7	58	0	0.0	0.0
SUW	12	6	0.5	1.5	13	1.1	3.3	51	1	0.1	0.3
Totals	315	496			359			1,360	26		
Mean			1.6	1.3		1.1	1.0			0.1	0.1

**DM = main channel dammed pool caused by beaver*
DMW = main channel dammed pool caused by large woody debris
GLD = glide
HGR = high gradient riffle
LGR = low gradient riffle
RUN = run
SLB = lateral scour pool formed by boulder
SLM = lateral scour pool formed by meander
SLW = lateral scour pool formed by large woody debris
SMB = mid-channel scour pool formed by boulder
SMW = mid-channel scour pool formed by large woody debris
SPB = plunge pool formed by boulder
SPW = plunge pool formed by large woody debris
STP = step-pool
SUW = underscour pool formed by large woody debris

West Fork are below average when compared to reference reaches in the region with similar morphological characteristics.

Moderate levels of riparian harvests have occurred on the West Fork during the 1950s. These riparian harvests primarily involved the individual selection of larger diameter trees in the riparian zone throughout the existing project area and did not include clearcut methods in the riparian zone. This past individual-selection harvest method likely reduced the amount of potentially recruitable large woody debris to the West Fork and could be associated with existing below-average amounts of large woody debris in the stream. Consequently, there is a low to moderate existing direct and indirect impact to bull trout and westslope cutthroat trout habitat as a result of low levels of large-woody-debris recruitment in the West Fork.

- ***Riparian Zone***

  The stream riparian area is broadly defined as the interface or linkage between the terrestrial and aquatic zones, and this area is critical for regulating large-woody-debris recruitment, thermal regimes,

*TABLE D-5 - CALCULATIONS OF SITE POTENTIAL TREE HEIGHT AT 100 YEARS**

AREA	ADJACENT STREAM	SAMPLE	SPECIES	HEIGHT (FEET)	AGE (YEARS)	SITE INDEX	SITE-POTENTIAL TREE HEIGHT AT 100 YEARS (FEET)	MEAN SITE-POTENTIAL TREE HEIGHT AT 100 YEARS (FEET)	REFERENCE
II-H	West Fork	1A-1	Englemann spruce	68	75	50	75		USFS INT-42
II-H	West Fork	1B-1	Englemann spruce	115	158	70	103		USFS INT-42
II-H	West Fork	1B-2	Englemann spruce	98	138	60	88		USFS INT-42
II-H	West Fork	2A-1	Subalpine fir	84	70	40	110		USFS RN-71
II-H	West Fork	2A-2	Englemann spruce	98	126	60	88		USFS INT-42
II-H	West Fork							**93**	
II-G	West Fork	3A-1	Subalpine fir	48	65	30	91		USFS RN-71
II-G	West Fork	3B-1	Englemann spruce	65	100	40	63		USFS INT-42
II-G	West Fork	3C-1	Englemann spruce	49	40	60	88		USFS INT-42
II-G	West Fork	3D-1	Subalpine fir	71	105	30	91		USFS RN-71
II-G	West Fork							**83**	
II-P	West Fork	5A-1	Subalpine fir	57	58	30	91		USFS RN-71
II-P	West Fork	5A-2	Englemann spruce	80	154	50	75		USFS INT-42
II-P	West Fork	5B-1	Subalpine fir	38	33	40	110		USFS RN-71
II-P	West Fork	5C-1	Englemann spruce	57	44	60	88		USFS INT-42
II-P	West Fork	5C-2	Subalpine fir	75	112	30	91		USFS RN-71
II-P	West Fork							**91**	
II-C	West Fork	7A-1	Subalpine fir	61	85	30	91		USFS RN-71
II-C	West Fork	7A-2	Englemann spruce	58	60	50	75		USFS INT-42
II-C	West Fork	7B-1	Englemann spruce	58	63	50	75		USFS INT-42
II-C	West Fork	7B-2	Englemann spruce	80	105	50	75		USFS INT-42
II-C	West Fork	7C-1	Subalpine fir	37	50	30	91		USFS RN-71
II-C	West Fork							**81**	

**Samples were taken by DNRC personnel on 3/3/2004 and 3/4/2004. Samples were taken from random trees with unimpeded growth at a distance of 50 feet from the bank-full slope break.*

stream nutrient inputs, and water quality among other variables (*Hansen et al 1995*). This section will consider how riparian-zone function, in particular, is related to the potential for large-woody-debris recruitment. Studies of large-woody-debris recruitment to the stream channel suggest that the primary zone of recruitment is equal to the height of the tallest trees growing in the riparian zone (*Robinson and Beschta 1990, Bilby and Bisson 1998*). The site-potential tree height at 100 years is used to estimate the extent of the primary zone of large-woody-debris recruitment for riparian areas adjacent to proposed harvest areas. Calculations of the site-potential tree height for riparian zones adjacent to various proposed harvest areas are displayed in *TABLE D-5 - CALCULATIONS OF SITE POTENTIAL TREE HEIGHT AT 100 YEARS**.

As described *TABLE D-5*, past individual-selection harvesting has likely reduced the amount of potentially recruitable large woody debris to the West Fork. This selective harvest is known to have occurred within those riparian zones delineated by the mean site-potential tree height at 100 years in *TABLE D-5 - CALCULATIONS OF SITE-POTENTIAL TREE HEIGHT AT 100 YEARS**.

Consequently, there are low to moderate existing direct and indirect impacts to bull trout and westslope cutthroat trout habitat as a result of riparian-zone function in the West Fork.

- ***Stream Temperature***

  Stream temperature data for the West Fork, available for only 2001 and 2003, is displayed in *TABLE D-6 - STREAM TEMPERATURE DATA FOR THE WEST FORK**. The 'upper' recording station is located in the northwest quarter of Section 29, T34N, R23W, and the 'lower' recording station is located in the southwest quarter of Section 34, T34N, R23W. Data indicates that the annual mean weekly maximum temperature at the upper recording station is relatively stable (11.3 degrees Celsius during 2001 and 2003.) Data also indicates that the mean weekly maximum temperature at the lower recording station is more variable than the upper station (11.6 to 13.2 degrees Celsius during 2001 and 2003). During the 2 seasons of record, the change in stream temperature through the lower half of the project area ranged from 0.3 to 1.9 degrees Celsius.

  In respect to bull trout, the temperature ranges described in *TABLE D-6 - STREAM TEMPERATURE DATA FOR THE WEST FORK** are at the upper end of the species'

TABLE D-6 - STREAM TEMPERATURE DATA FOR THE WEST FORK*

SITE NAME	SEASONAL MAXIMUM		SEASONAL MAXIMUM		7-DAY AVERAGES		DAYS GREATER THAN 10.0 CELSIUS	DAYS GREATER THAN 15.0 CELSIUS
	DATE	VALUE	DATE	VALUE	DATE	MAXIMUM		
West Fork 2001 - Upper	08/07/01	11.8	07/07/01	6.4	08/09/01	11.3	36	0
West Fork 2001 - Lower	08/07/01	14.1	08/06/01	8.2	08/09/01	13.2	61	0
West Fork 2003 - Upper	07/23/03	11.7	07/18/03	5.9	07/22/03	11.3	35	0
West Fork 2003 - Lower	07/23/03	12.1	07/18/03	6.0	07/21/03	11.6	40	0

**Samples obtained by DNRC hydrologists using Stowaway (Onset Corporation) data loggers.*

tolerances as observed in various studies. *Fraley and Shepard (1989)* rarely observed juvenile bull trout in streams exceeding 15 degrees Celsius. *Gamett (2002)* did not find bull trout where maximum stream temperatures exceeded 20 degrees Celsius. *Reiman and Chandler (1999)* found that bull trout are most frequently observed in streams having summer maximum temperatures of approximately 13 to 14 degrees Celsius.

No specific conclusions regarding stream temperature trends in the West Fork can be drawn from these current observations, but this data will be indispensable in future habitat assessment and monitoring efforts. Although insufficient data is available for describing existing trends in stream temperature, no existing direct and indirect impacts to bull trout and westslope cutthroat trout habitat are likely as a result of stream temperature in the West Fork.

- ***Connectivity***

  Currently, 2 bridge crossings of the West Fork are in the project area in Sections 29 and 34, T34N, R23W. These crossings provide full passage of all life stages of bull trout and westslope cutthroat trout. No naturally occurring or manmade barriers to either trout exist on the West Fork in the project area.

  There are no existing direct and indirect impacts to bull trout and westslope cutthroat trout habitat as a result of disconnectivity on the West Fork.

Summary of West Fork Existing Conditions

The entire West Fork watershed, including subbasins, has undergone extensive, but irregular timber harvesting through much of the past century, up to approximately 20 years ago. Existing, nonspecific pressures on bull trout and westslope cutthroat trout may include past upland or riparian timber harvesting and secondary road construction. The potential existing impacts from these past events may include increased sedimentation, increased peak flows, modifications of the hydrograph, and reduced large-woody-debris recruitment and channel stability (*Montana Bull Trout Scientific Group 1995, USFWS 2002b*). In the West Fork, an estimated 3 percent increase in the flow regime may be resulting in a modified hydrograph, and reduced large-woody-debris recruitment has been observed.

Moderate levels of riparian harvests have occurred on the West Fork during the 1950s. This riparian harvest primarily involved the individual selection of larger diameter trees in the riparian zone throughout the existing project area, and did not include clearcut methods in the riparian zone. This past individual-selection harvest method likely reduced the amount of potentially recruitable large woody debris to the West Fork and could be associated with the existing below-average amounts of large woody debris in the stream (see *West Fork Bull Trout and Westslope Cutthroat Trout Habitat - Large Woody Debris*). This riparian canopy removal may also have led to temporarily increased stream temperatures as a result of increased incoming direct solar energy, but to accurately qualify the extent of this potential past impact is not possible. Nonetheless, this specific pattern

of past riparian management collectively constitutes low past and present impacts to bull trout and westslope cutthroat trout in the West Fork.

No data is available regarding recreational fishing pressure on bull trout and westslope cutthroat trout in the West Fork (*MFISH 2004*); therefore, these potential past and present impacts are likely very low.

The existing road system in the project area has been assessed for specific sources of sedimentation to streams in the West Fork watershed. Estimates indicate that approximately 25.5 tons per year of road material (sediment) are contributed to streams in the West Fork watershed by the existing road system (see *APPENDIX C - WATERSHED AND HYDROLOGY ANALYSIS*).

Overall, low to moderate collective past and present impacts to bull trout and westslope cutthroat trout are likely in the West Fork as a result of the existing conditions described above.

➢ *STRYKER CREEK*

Stryker Creek is a third-order stream and the entire reach within the project area is considered fish bearing.

Stryker Creek Bull Trout and Westslope Cutthroat Trout Populations

- **Presence**

  Very little fisheries data is available for Stryker Creek and no known fisheries surveys have been conducted on the creek. Although this subbasin is not likely utilized by bull trout as spawning habitat for disjunct populations associated with Whitefish and Upper Whitefish lakes, a possibility exists that the lower reaches of the stream are utilized as short-term rearing habitat by juvenile bull trout that later become adfluvial or fluvial life forms. Also, the lower reaches of the stream could possibly be utilized to some degree by resident bull trout.

  Westslope cutthroat trout are known to exist in Stryker Creek; however, the degree to which westslope cutthroat trout utilize the stream is not well studied. Stryker Creek most certainly provides some level of spawning and rearing habitat to resident westslope cutthroat trout and, possibly, adfluvial and fluvial life forms associated with Whitefish and Upper Whitefish lakes.

  Due to the lack of historic and comparable population-presence data, there are no apparent existing direct and indirect impacts to bull trout and westslope cutthroat trout population presence in Stryker Creek.

- **Genetics**

  Information regarding the existing conditions of bull trout genetics in Stryker Creek is the same as that for the West Fork -see *West Fork Bull Trout and Western Cutthroat Trout Populations - Genetics).*

  Site-specific information from DFWP regarding westslope cutthroat trout genetics in Stryker Creek is unavailable. A DFWP genetic survey in 1984 of 26 westslope cutthroat trout from the West Fork found the subspecies slightly introgressed with rainbow trout. The genetic purity of westslope cutthroat trout was determined at that time to be 97.4 percent (*MFISH 2004*). A possibility exists that genetic introgression among individual westslope cutthroat trout from the West Fork has spread upstream into Stryker Creek. Conversely, there is the

possibility of a remnant population of westslope cutthroat trout in the upstream reaches of Stryker Creek that may be genetically pure.

Due to the possibility of bull trout and brook trout hybridization and the known occurrence of introgressed westslope cutthroat trout, existing low to moderate direct and indirect impacts to bull trout and westslope cutthroat trout population genetics in Stryker Creek are possible.

Stryker Creek Bull Trout and Westslope Cutthroat Trout Habitat

- **Flow Regime**

  Flow regime is the range of discharge frequencies and intensities in a specific watershed that occur throughout the year. The analysis of hydrologic data for the Stryker Creek subbasin indicates that the existing average flow regime for the stream is approximately 3.3 percent above the range of naturally occurring conditions, which is primarily a result of past forest crown removal. The range of naturally occurring conditions is considered representative of those flow regimes in a fully forested, mature (20 to 30 years old) watershed.

  Changes in flow regime can affect bull trout and westslope cutthroat trout through modifications of stream morphology, sediment budget, streambank stability, stream temperature ranges, and channel formations. There is likely no detectable existing impact on these specific habitat characteristics as a result of the estimated 3.3 percent increase in flow regime.

  Changes in flow regime have been know to affect bull trout and westslope cutthroat trout spawning migration, habitat available for spawning, and embryo survival; for this reason there is a very low potential for direct and indirect impacts to bull trout and westslope cutthroat trout as a result of flow regime modifications in Stryker Creek.

- **Sediment**

  Field surveys of Stryker Creek within the project area have found the *Rosgen* stream morphological type to be B3; this is characteristic of cobble-dominated channels with lesser amounts of gravels, boulders, and sands (*Rosgen 1996*). Stream gradients range primarily from 4 to 6 percent. *Pfankuch (1978)* stream stability scores from reaches within the project area range from 73 to 76, which is considered fair for B3 stream types.

  Based on these observations, existing direct and indirect impacts to bull trout and westslope cutthroat trout habitat are not likely as a result of sediment in Stryker Creek.

- **Channel Forms**

  A description of channel formation that can be used to describe existing bull trout and westslope cutthroat trout habitat in Stryker Creek is the *Montgomery/Buffington* classification (*Montgomery and Buffington 1997*) and *R1/R4 Fish Habitat Standard Inventory* (*Overton et al 1997*). The stream formations of Stryker Creek, from the confluence with the West Fork (river mile 0.00) in Section 29, T34N, R23W, upstream through the project area and to a point (river mile 1.45) in Section 19, T34N, R24W, is broadly described as a transitional zone between 'forced pool-riffle' and 'plane-

bed' classifications to 'forced step-pool' and 'step-pool' classifications, respectively. The 'forced pool-riffle' and 'forced step-pool' channel forms are generally a function of large-woody-debris recruitment to the bankfull area of the stream. The 'forced pool-riffle' channel form typically has pool frequencies of 1:5 to 1:7, where the later ratio is channel width, and gradients less than 3 percent (*Montgomery and Buffington 1997*). Both 'step-pool' channel forms typically have pool frequencies of 1:1 to 1:4, where the later ratio is channel width, and gradients of 3 to 8 percent (*Montgomery and Buffington 1997*). The 'plane bed' channel form typically does not have pools and generally occurs in gradients of 1 to 4 percent (*Montgomery and Buffington 1997*).

R1/R4 Fish Habitat Standard Inventory (*Overton et al 1997*) is not available for Stryker Creek within the project area.

Although insufficient data is available for describing existing trends in channel forms, no existing direct and indirect impacts to bull trout and westslope cutthroat trout habitat are likely as a result of channel formations in Stryker Creek.

- **Large Woody Debris**

  Large woody debris is recruited to the stream channel from adjacent and upstream riparian vegetation; this material is a critical component in the formation of complex bull trout and westslope cutthroat trout habitat. All life stages of bull trout and westslope cutthroat trout have been observed closely associating with large woody debris in the Flathead River basin (*Platt 1984, Shepard et al 1984*). Large-woody-debris recruitment rates to Stryker Creek throughout the project area can be described using large-woody-debris counts per stream length; this data was collected during a survey in June 2004 using the protocol described in *Overton et al 1997*. Two separate 1,000-foot, large-woody-debris survey sections were located on Stryker Creek adjacent to proposed Harvest Area II-P; the mean large-woody-debris count per 1,000 feet in Stryker Creek was determined to be 131 pieces.

  Data from reference reaches (*Harrelson et al 1994*) in the Flathead River basin region indicate that the average amount of large woody debris in undisturbed 'B' channel types (Rosgen morphological stream type) is 123 pieces per 1000 feet, plus or minus 57 percent (*Bower 2004*). This data suggests that existing amounts of large woody debris in Stryker Creek are average when compared to reference reaches in the region with similar morphological characteristics.

  Consequently, there are no direct and indirect impacts to bull trout and westslope cutthroat trout habitat as a result of large-woody-debris recruitment in Stryker Creek.

- **Riparian Zone**

  Proposed Harvest Area II-P is the only area immediately adjacent to Stryker Creek. The site-potential tree height in the riparian zone of this proposed harvest area was calculated for the West Fork. The watershed proximity and the similarity of stand types and growth conditions is sufficient enough that the site-potential tree-height values for the West Fork can be applied to Stryker Creek within proposed Harvest

Area II-P. Therefore, site potential tree height at 100 years for this riparian zone is determined to be 91 feet (*TABLE C-5 - CALCULATIONS OF SITE-POTENTIAL TREE HEIGHT AT 100 YEARS**).

There are no existing direct and indirect impacts to bull trout and westslope cutthroat trout habitat as a result of riparian-zone function adjacent to Stryker Creek.

- **Stream Temperature**

  Stream-temperature data is not available for Stryker Creek within the project area. Although Stryker Creek is quite similar to the West Fork in respect to many environmental conditions, stream-temperature conditions and data generally can be moderately variable between subbasins.

  Although sufficient data is unavailable for describing existing trends in stream temperature, no existing direct and indirect impacts to bull trout and westslope cutthroat trout habitat are likely as a result of stream temperature in Stryker Creek.

- **Connectivity**

  Currently, 1 bridge crosses Stryker Creek in the northeast quarter of Section 30, T34N, R23W, of the project area. Although this bridge is a failing native-material structure, this crossing provides full passage of all life stages of bull trout and westslope cutthroat trout. No naturally occurring or manmade barriers to bull trout or westslope cutthroat trout are on Stryker Creek in the project area.

  There are no existing direct and indirect impacts to bull trout and westslope cutthroat trout habitat as a result of disconnectivity on Stryker Creek.

Summary of Stryker Creek Existing Conditions

The entire Stryker Creek watershed has undergone extensive, but irregular timber harvesting through much of the past century, up to approximately 20 years ago. Existing, nonspecific pressures on bull trout and westslope cutthroat trout may include past upland or riparian timber harvesting and secondary road construction. The potential existing impacts from these past events may include increased sedimentation, increased peak flows, modifications of the hydrograph, and reduced large-woody-debris recruitment and channel stability (*Montana Bull Trout Scientific Group 1995, USFWS 2002b*). In Stryker Creek, an estimated 3.3 percent increase in the flow regime may be resulting in a modified hydrograph.

No data is available regarding recreational fishing pressure on bull trout and westslope cutthroat trout in Stryker Creek (*MFISH 2004*); therefore, these potential past and present impacts are likely very low.

The existing road system in the project area has been assessed for specific sources of sedimentation to streams in the Stryker Creek watershed. Estimates indicate that approximately 2.8 tons per year of road-material sediment are contributed to streams in the Stryker Creek watershed by the existing road system (see *APPENDIX C - WATERSHED AND HYDROLOGY ANALYSIS*).

Overall, low collective past and present impacts to bull trout and westslope cutthroat trout are likely in Stryker Creek as a result of the existing conditions described above.

➢ JOHNSON CREEK

Johnson Creek is a third-order stream and the entire reach within the project area is considered fish bearing. A variable portion of the lower reach immediately above the confluence with the West Fork exhibits discontinuous, subterrain flows during low-flow periods of the year.

Johnson Creek Bull Trout and Westslope Cutthroat Trout Populations

- **Presence**

  Limited fisheries data is available for Johnson Creek, and no known fisheries population surveys have been conducted on the stream. Although this subbasin is not likely utilized by bull trout as spawning habitat for disjunct populations associated with Whitefish and Upper Whitefish lakes, the lower perennial reaches of the stream are possibly utilized as short-term rearing habitat by juvenile bull trout that later become adfluvial or fluvial life forms. Also, the lower perennial reaches of the stream could possibly be utilized to some degree by resident bull trout.

  Westslope cutthroat trout are known to exist in Johnson Creek; however, the degree to which westslope cutthroat trout utilize the stream is not well studied. Johnson Creek most certainly provides some level of spawning and rearing habitat to resident westslope cutthroat trout and possibly adfluvial and fluvial life forms associated with Whitefish and Upper Whitefish lakes.

  Due to the lack of historic and comparable population-presence data, there are no apparent existing direct and indirect impacts to bull trout and westslope cutthroat trout population presence in Johnson Creek.

- **Genetics**

  Information regarding the existing conditions of bull trout genetics in Johnson Creek is the same as that for the West Fork (see *West Fork Bull Trout and Westslope Cutthroat Trout Populations - Genetics*).

  A 1992 DFWP genetic survey of 52 westslope cutthroat trout from Johnson Creek (river mile 1.2 to 1.3) found the subspecies slightly introgressed with Yellowstone cutthroat trout. The genetic purity of westslope cutthroat trout was determined at that time to be 98.9 percent (*MFISH 2004*). A later (1998) DFWP genetic survey of 3 westslope cutthroat trout from an upstream reach of Johnson Creek (river mile 2.0 to 2.1) found samples to be genetically pure. The possibility exists that the genetic introgression that has occurred among the westslope cutthroat trout population within the reach of river mile 1.2 to 1.3 has since spread further upstream into Johnson Creek. Conversely, the possibility also exists that the population representing genetically-pure specimens of westslope cutthroat trout in upstream reaches of Johnson Creek may remain genetically isolated.

  Due to the possibility of bull trout and brook trout hybridization and the known occurrence of introgressed westslope cutthroat trout, there are possible existing low to moderate direct and indirect impacts to bull trout and westslope cutthroat trout population genetics in Johnson Creek.

Johnson Creek Bull Trout and Westslope Cutthroat Trout Habitat

- **Flow Regime**

  Flow regime is the range of discharge frequencies and intensities in a specific watershed that occur throughout the year. The analysis of hydrologic data for the Johnson Creek subbasin indicates that the existing average flow regime for the stream is approximately 3.5 percent above the range of naturally occurring conditions (see *APPENDIX D - WATERSHED AND HYDROLOGY ANALYSIS*), which is primarily a result of past forest crown removal. The range of naturally occurring conditions is considered representative of those flow regimes in a fully forested, mature (20 to 30 years old) watershed.

  Changes in flow regime can affect bull trout and westslope cutthroat trout through modifications of stream morphology, sediment budget, streambank stability, stream temperature ranges, and channel formations. There is likely no detectable existing impact on these specific habitat characteristics as a result of the estimated 3.5 percent increase in flow regime.

  Changes in flow regime have been known to affect bull trout and westslope cutthroat spawning migration, habitat available for spawning, and embryo survival; for this reason, there is very low potential for direct and indirect impacts to bull trout and westslope cutthroat trout as a result of flow regime modifications in Johnson Creek.

- **Sediment**

  Field surveys of the reach of Johnson Creek adjacent to proposed Harvest Area II-C and within the project area have found the overall *Rosgen* stream morphological type to be B4; this is characteristic of gravel-dominated channels, with lesser amounts of cobbles, boulders, and sands (*Rosgen 1996*). The stream gradient in this reach is approximately 3 percent. The *Pfankuch (1978)* stream stability score for this reach is 79, which is considered fair for B4 stream types.

  Based on these observations, no existing direct and indirect impacts to bull trout and westslope cutthroat trout habitat are likely as a result of sediment in Johnson Creek.

- **Channel Forms**

  A description of channel formation that can be used to describe existing bull trout and westslope cutthroat trout habitat in Johnson Creek is the *Montgomery/Buffington* classification (*Montgomery and Buffington 1997*) and *R1/R4 Fish Habitat Standard Inventory* (*Overton et al 1997*). The stream formations of Johnson Creek, from the confluence with the West Fork (river mile 0.00) in Section 3, T33N, R23W, upstream through the project area and to a point (river mile 1.46) in the southwest quarter of Section 32, T34N, R23W, is broadly described as exhibiting both 'pool-riffle' and 'forced pool-riffle' *Montgomery/Buffington* classifications. The 'forced pool-riffle' channel form is generally a function of large-woody-debris recruitment to the bankfull area of the stream, and both channel forms typically have pool frequencies of 1:5 to 1:7, where the later ratio is channel width (*Montgomery and Buffington 1997*). The stream formations of Johnson Creek, from river mile 1.46 upstream through the project area and to

a point (river mile 3.05) in Section 31, T34N, R23W, is broadly described as exhibiting 'step-pool', 'forced step-pool', and some 'cascade' *Montgomery/Buffington* classifications. Both 'step-pool' and 'forced step-pool' channel forms typically have pool frequencies of 1:1 to 1:4, where the later ratio is channel width, and gradients of 3 to 8 percent (*Montgomery and Buffington 1997*). The 'cascade' channel form typically has pool frequencies of 1:<1, where the later ratio is channel width, and gradients of 4 to 20 percent (*Montgomery and Buffington 1997*).

R1/R4 Fish Habitat Standard Inventory (*Overton et al 1997*) is not available for Stryker Creek within the project area.

Although sufficient data is unavailable for describing existing trends in channel forms, no existing direct and indirect impacts to bull trout and westslope cutthroat trout habitat are likely as a result of channel formations in Johnson Creek.

- **Large Woody Debris**

  Large-woody-debris count data is not available for Johnson Creek within the project area. Although Johnson Creek is a lower-order tributary to the West Fork, existing large-woody-debris counts within the project area are likely quite similar to those in the West Fork. This is probably attributed to watershed proximity, similar stand types and growth conditions, and similar soil and geologic conditions.

  Therefore, although sufficient data is unavailable to specifically describe existing conditions of large woody debris in Johnson Creek, low to moderate existing direct and indirect impacts to bull trout and westslope cutthroat trout habitat are likely as a result of the low levels of large-woody-debris recruitment.

- **Riparian Zone**

  Proposed Harvest Area II-C is the only area immediately adjacent to Johnson Creek. Specific calculations of the site-potential tree height in the riparian zone adjacent to this proposed harvest area are not available. However, the site-potential tree height in the riparian zone of this proposed harvest area was calculated for the West Fork. There is sufficient watershed proximity and similarity of stand types and growth conditions that the site-potential tree-height values for the West Fork can be applied to Johnson Creek within proposed Harvest Area II-C. Therefore, the site-potential tree height at 100 years for this riparian zone is determined to be 81 feet (*TABLE C-5 - CALCULATIONS OF SITE-POTENTIAL TREE HEIGHT AT 100 YEARS**).

  There are likely no existing direct and indirect impacts to bull trout and westslope cutthroat trout habitat as a result of riparian-zone function adjacent to Johnson Creek.

- **Stream Temperature**

  Stream-temperature data is not available for Johnson Creek within the project area. Although Johnson Creek is quite similar to the West Fork in respect to many environmental conditions, stream-temperature conditions and data generally can be moderately variable between subbasins.

  Although insufficient data is available for describing existing trends in stream

temperature, no existing direct and indirect impacts to bull trout and westslope cutthroat trout habitat are likely as a result of stream temperature in Johnson Creek.

- **Connectivity**

  Currently 1 culvert crossing and 3 bridge crossings exist on Johnson Creek in the project area. The culvert is located in the southeast quarter of Section 33, T34N, R23W, and the bridges are located in the southeast quarter of Section 32, the southwest quarter of Section 32, and the southeast quarter of Section 31, all in T32N, R23W. The 3 bridge crossings provide full passage of all life stages of bull trout and westslope cutthroat trout.

  A variable portion of the lower reach immediately above the confluence with the West Fork exhibits discontinuous, subterrain flows during low-flow periods of the year. With discontinuous flow, this reach acts as a naturally occurring seasonal barrier to bull trout and westslope cutthroat trout migration. Bull trout and westslope cutthroat trout passage through this reach is most likely possible only during runoff or other bankfull flow events.

  The culvert on Johnson Creek within the project area is located on the lower reach with discontinuous flow. This culvert was surveyed during 2003 as part of the *DNRC Fish Passage Assessment Project;* information collected during that survey was used to model seasonal low and high flows, along with juvenile and adult cutthroat trout passage through the structure using *FishXing* software (*1999*). The results of those modeling efforts indicate that the culvert is an upstream migration barrier to juveniles and most adult westslope cutthroat trout. Only those adults capable of attaining burst swim speeds of 9.75 feet per second for 7.5 seconds are likely able to migrate upstream through the culvert during low to bankfull flows. These results are likely representative of bull trout and westslope cutthroat trout swim performances and suggest that only a portion of the strongest swimming adults are able to migrate upstream through the structure.

  Due to very limited upstream migration potential through the culvert located in the lower reach with seasonal, discontinuous flow, there is a moderate existing direct and indirect impact to bull trout and westslope cutthroat trout habitat as a result of disconnectivity on Johnson Creek.

Johnson Creek Existing Cumulative Impacts

The entire Johnson Creek watershed has undergone extensive, but irregular, timber harvesting through much of the past century, up to approximately 20 years ago. Existing, nonspecific pressures on bull trout and westslope cutthroat trout may include past upland or riparian timber harvesting and secondary road construction. The potential existing impacts from these past events may include increased sedimentation, increased peak flows, modifications of the hydrograph, and reduced large-woody-debris recruitment and channel stability (*Montana Bull Trout Scientific Group 1995, USFWS 2002b*).

Moderate levels of riparian harvesting have occurred on Johnson Creek during the previous harvest period described above. This riparian harvest primarily involved the individual selection

of larger-diameter trees in the riparian zone throughout the existing project area and did not include clearcut methods in the riparian zone. This past individual-selection harvest method likely reduced the amount of potentially recruitable large woody debris to Johnson Creek and could be associated with possible below-average amounts of large woody debris in the stream (see *West Fork Bull Trout and Westslope Cutthroat Trout Habitat - Large Woody Debris* under *Stryker Creek*). This riparian canopy removal may also have led to temporarily increased stream temperatures as a result of increased incoming direct solar energy, but to accurately qualify the extent of this potential past impact is not possible. Nonetheless, this specific pattern of past riparian management collectively constitutes low past and present impacts to bull trout and westslope cutthroat trout in Johnson Creek.

No data is available regarding recreational fishing pressure on bull trout and westslope cutthroat trout in Johnson Creek (*MFISH 2004*); therefore, potential past and present impacts are likely very low.

The existing road system in the project area has been assessed for specific sources of sedimentation to streams in the Johnson Creek watershed. Estimates indicate that approximately 5.2 tons per year of road material (sediment) are contributed to streams in the Johnson Creek watershed by the existing road system (see *APPENDIX D - WATERSHED AND HYDROLOGY ANALYSIS*).

Overall, low to moderate collective past and present impacts to bull trout and westslope cutthroat trout are likely in Johnson Creek as a result of the existing conditions described above.

ALTERNATIVE EFFECTS

DIRECT AND INDIRECT EFFECTS FOR THE WEST FORK, STRYKER CREEK, AND JOHNSON CREEK

Bull Trout and Westslope Cutthroat Trout Populations

~ ***Presence***

- ***Direct and Indirect Effects of No-Action Alternative A***

  This no-action alternative would not be expected to have any direct or indirect impacts to bull trout and westslope cutthroat trout population presence in the West Fork, or Stryker or Johnson creeks beyond those described under *EXISTING CONDITIONS*.

- ***Direct and Indirect Effects of Action Alternative B***

  The existing conditions describe confirmed bull trout and westslope cutthroat trout presence in the West Fork and Johnson Creek and the likely presence of one or both species in Stryker Creek. Redd count and estimated population data from the West Fork indicate that habitat utilization specific to this stream is variable for both bull trout and westslope cutthroat trout. It is reasonable to assume that relatively proportionate levels of variability in habitat utilization also occur in Stryker and Johnson creeks.

  Action Alternative B would not involve direct or indirect impacts to any specific bull trout or westslope cutthroat trout populations in the project area. Therefore, Action Alternative B would have no direct or indirect impact to bull trout and westslope cutthroat trout population presence in the West Fork or

Stryker and Johnson creeks beyond those described under *EXISTING CONDITIONS*.

- ***Direct and Indirect Effects of Action Alternative C***

  Direct and indirect impacts to bull trout and westslope cutthroat trout population presence as a result of Action Alternative C are expected to be the same as those described for Action Alternative B.

~ *Genetics*

- ***Direct and Indirect Effects of No-Action Alternative A***

  No-Action Alternative A would not be expected to have any direct or indirect impacts to bull trout and westslope cutthroat trout population genetics in the West Fork or Stryker and Johnson creeks beyond those described under *Existing Conditions*.

- ***Direct and Indirect Effects of Action Alternative B***

  The eastern brook trout may negatively affect bull trout population genetics in the West Fork and Stryker and Johnson creeks through hybridization, as described in the *EXISTING CONDITIONS*. However, the introduction, migration, and spawning behavior of nonnative eastern brook trout and the consequent population biological interactions with bull trout are beyond the control and regulatory jurisdiction of DNRC land-management activities.

  Different strains of nonnative and historic hatchery rainbow trout may hybridize with westslope cutthroat trout, which can introduce long-term genetic introgression to pure westslope cutthroat trout populations in the West Fork and Stryker and Johnson creeks. The genetic introgression of westslope cutthroat trout may also arise from hybridization with Yellowstone cutthroat trout, through either local introduction of the subspecies or residual introgression introduced by westslope cutthroat trout that may have originally come from historic cutthroat trout hatcheries. Introgression, in general, negatively affects genetically pure westslope cutthroat trout, and, as described in *EXISTING CONDITIONS*, this is known to have occurred at a minimum in the West Fork and Johnson Creek (*MFISH 2004*). However, the introduction, migration, and spawning behavior of nonnative rainbow trout and the consequent population biological interactions with westslope cutthroat trout are beyond the control and regulatory jurisdiction of DNRC land-management activities. Additionally, the genetic pathway within westslope cutthroat trout populations of genes specific to Yellowstone cutthroat trout is also beyond the control of DNRC land-management activities.

  Therefore, Action Alternative B would not be expected to have any direct or indirect impacts to bull trout and westslope cutthroat trout population genetics in the West Fork or Stryker and Johnson creeks beyond those described under *EXISTING CONDITIONS*.

- ***Direct and Indirect Effects of Action Alternative C***

  Direct and indirect environmental effects of Action Alternative C to bull trout and westslope cutthroat trout population genetics would be expected to be the same as those described for Action Alternative B.

~ Flow Regime

- ***Direct and Indirect Effects of No-Action Alternative A***

  No-Action Alternative A would not be expected to have any direct or indirect impacts to the flow-regime component of bull trout and westslope cutthroat trout habitat in the West Fork or Stryker or Johnson creeks beyond those described under *EXISTING CONDITIONS*.

- ***Direct and Indirect Effects of Action Alternative B***

  Changes in flow regime can affect bull trout and westslope cutthroat trout spawning migration, spawning behavior, potential spawning habitat, and embryo survival through modifications of stream morphology, sediment budget, streambank stability, stream temperature ranges, and channel formations. An analysis of potential actions related to Action Alternative B indicates that water yields in the West Fork would increase from approximately 3.4 percent (existing conditions) to approximately 6.0 percent, approximately 3.3 percent (existing conditions) to approximately 4.1 percent in Stryker Creek, and approximately 3.5 percent (existing conditions) to approximately 3.9 percent in Johnson Creek (see *APPENDIX D - WATERSHED AND HYDROLOGY ANALYSIS*).

  The range of potential water-yield increases to streams with bull trout and westslope cutthroat trout habitat in the project area is approximately from 0.4 percent to 2.6 percent. With respect to those existing conditions described earlier, these potential modifications of flow regimes as a result of Action Alternative B are expected to have negligible, if any, direct and indirect impacts to bull trout and westslope cutthroat trout in the West Fork and Stryker and Johnson creeks.

- ***Direct and Indirect Effects of Action Alternative C***

  Changes in flow regime can affect bull trout and westslope cutthroat trout spawning migration, spawning behavior, potential spawning habitat, and embryo survival through modifications of stream morphology, sediment budget, streambank stability, stream temperature ranges, and channel formations. An analysis of potential actions related to Action Alternative C indicate that water yields in the West Fork would increase from approximately 3.4 percent (existing conditions) to approximately 5.0 percent, approximately 3.3 percent (existing conditions) to approximately 3.5 percent in Stryker Creek, and approximately 3.5 percent (existing conditions) to approximately 3.7 percent in Johnson Creek (see *APPENDIX C - WATERSHED AND HYDROLOGY ANALYSIS*).

  The range of potential water yield increases to streams with bull trout and westslope cutthroat trout habitat in the project area is approximately 0.2 percent to approximately 1.6 percent. With respect to those existing conditions described earlier, these potential modifications of flow regimes as a result of Action Alternative C are expected to have negligible, if any, direct and indirect impacts to bull trout and westslope cutthroat trout in the West Fork and Stryker and Johnson creeks.

Bull Trout and Westslope Cutthroat Trout Habitat

~ **Sediment**

- ***Direct and Indirect Effects of No-Action Alternative A***

  No-Action Alternative A would not expected to have any direct or indirect impacts to the sediment component of bull trout and westslope cutthroat trout habitat in the West Fork or Stryker and Johnson creeks beyond those described under *EXISTING CONDITIONS*.

- ***Direct and Indirect Effects of Action Alternative B***

  Modifications of stream sediment size classes, especially with trends toward fine size classes, could adversely affect bull trout and westslope cutthroat trout in the project area by reducing the quality of spawning habitat, in-stream cover, rearing habitat, and wintering habitat. Increased levels of fine sediments can be introduced to the stream system from various sources, including bank erosion due to stream channel instability, road features, and adjacent timber-harvesting operations.

  Data from *APPENDIX C - WATERSHED AND HYDROLOGY ANALYSIS* in this EIS indicates that the range of potential water-yield increases as a result of Action Alternative B is generally insufficient to facilitate the development of unstable stream channels.

  APPENDIX C - WATERSHED AND HYDROLOGY ANALYSIS also indicates that road improvements associated with Action Alternative B would reduce sedimentation to the West Fork and Stryker Creek by approximately 4.2 tons per year and by approximately 2.7 tons per year to Johnson Creek. Road improvement activities that remove or mitigate potential sediment sources may have temporary, unavoidable, and short-term impacts to the sediment component of streams (see *APPENDIX C - WATERSHED AND HYDROLOGY ANALYSIS*), which may correspond to a minor, short-term impact to bull trout or westslope cutthroat trout. However, these road improvements would provide a long-term, net-positive impact to bull trout and westslope cutthroat trout habitat in respect to sediment.

  Timber harvesting operations adjacent to the West Fork and Stryker and Johnson creeks would comply with SMZ laws. The SMZ laws are designed to provide adequate mitigations for the prevention of sedimentation to streams from adjacent timber-harvest-related activities.

  With respect to those existing conditions described earlier, the selection of Action Alternative B would likely provide net-positive direct and indirect impacts to the sediment component of bull trout and westslope cutthroat trout habitat in the West Fork and Stryker and Johnson creeks.

- ***Direct and Indirect Effects of Action Alternative C***

  Modifications of stream-sediment size classes, especially with trends toward fine size classes, could adversely affect bull trout and westslope cutthroat trout in the project area by reducing the quality of spawning habitat, in-stream cover, rearing habitat, and wintering habitat. Increased levels of fine sediments can be introduced to the stream system from various sources, including bank erosion due to stream channel instability, road features, and adjacent timber-harvesting operations.

Data from the *APPENDIX C - WATERSHED AND HYDROLOGY ANALYSIS* in this EIS indicates that the range of potential water-yield increases as a result of Action Alternative C is generally insufficient to facilitate the development of unstable stream channels.

The *APPENDIX C - WATERSHED AND HYDROLOGY ANALYSIS* also indicates that road improvements associated with Action Alternative C would reduce sedimentation to the West Fork and Stryker Creek by approximately 2.6 tons per year and by approximately 0.0 tons per year to Johnson Creek. Road-improvement activities that remove or mitigate potential sediment sources may have temporary, unavoidable, and short-term impacts to the sediment component of streams (see *APPENDIX C - WATERSHED AND HYDROLOGY ANALYSIS*), which may correspond to a minor, short-term impact to bull trout or westslope cutthroat trout. However, these road improvements would provide a long-term, net-positive impact to bull trout and westslope cutthroat trout habitat in respect to sediment.

Timber-harvesting operations adjacent to the West Fork and Stryker and Johnson creeks would comply with SMZ laws. The SMZ laws are designed to provide adequate mitigations for the prevention of sedimentation to streams from adjacent activities related to timber harvesting.

With respect to those existing conditions described earlier, the selection of Action Alternative C would likely provide net-positive direct and indirect impacts to the sediment component of bull trout and westslope cutthroat trout habitat in the West Fork and Stryker and Johnson creeks.

~ **Channel Forms**

- ***Direct and Indirect Effects of No-Action Alternative A***

  No-Action Alternative A would not be expected to have any direct or indirect impacts to the channel-form component of bull trout and westslope cutthroat trout habitat in the West Fork and Stryker and Johnson creeks beyond those described under *EXISTING CONDITIONS*.

- ***Direct and Indirect Effects of Action Alternative B***

  Potential changes to stream channel forms are primarily a function of modifications to flow regimes and consequent relationships with existing sediment size classes. As indicated earlier, modifications to the bull trout and westslope cutthroat trout habitat features of flow regime and sediment as a result of Action Alternative B are expected to be negligible or not occur at all.

  Therefore, with respect to those existing conditions described earlier, there are no foreseeable direct and indirect impacts to the channel form component of bull trout and westslope cutthroat trout habitat in the West Fork and Stryker and Johnson creeks.

- ***Direct and Indirect Effects of Action Alternative C***

  Potential changes to stream channel forms are primarily a function of modifications to flow regimes and consequent relationships with existing sediment size classes. As indicated earlier, modifications to the bull trout and westslope cutthroat trout habitat features of flow regime and sediment as a result of Action Alternative C are expected to be negligible or not occur at all.

Therefore, with respect to those existing conditions described earlier, there are no foreseeable direct and indirect impacts to the channel form component of bull trout and westslope cutthroat trout habitat in the West Fork and Stryker and Johnson creeks.

~ **Large Woody Debris**

- ***Direct and Indirect Effects of No-Action Alternative A***

  No-Action Alternative A would not be expected to have any direct or indirect impacts to the large woody debris component of bull trout and westslope cutthroat trout habitat in the West Fork or Stryker and Johnson creeks beyond those described under *EXISTING CONDITIONS*.

- ***Direct and Indirect Effects of Action Alternative B***

  Action Alternative B proposes varying levels of timber harvesting up to, but not within, 100 feet of the nearest stream bankfull edges of the West Fork (proposed Harvest Areas II-H, II-G, II-P, and II-C), Stryker Creek (proposed Harvest Area II-P), and Johnson Creek (proposed Harvest Area II-C). Potential large-woody-debris recruitment to the channels of these and other streams is a function of the distance from the stream channel that riparian trees may fall in order to contribute large woody debris. This distance from the stream channel is generally equal to the mean height of dominant and co-dominant trees (*Robinson and Beschta 1990, Bilby and Bisson 1998*), which is usually expressed as the site-potential tree height.

  As described in *EXISTING CONDITIONS*, the site-potential tree height at 100 years from sample sites in the riparian zone along both sides of the West Fork throughout the project area ranges from 81 to 93 feet. The riparian zones along Stryker and Johnson creeks are likely sufficiently similar to those in the West Fork that site-potential tree heights of 81 to 93 feet can also be applied to these areas. Since a no-harvest buffer of 100 feet would be established between the 3 streams and associated proposed harvest areas described above, rates of potential large-woody-debris recruitment to any of these 3 stream channels is not expected to be affected by any proposed harvest areas. Correspondingly, a study of large-woody-debris recruitment to stream channels in Alaska found that 99 percent of in-stream large woody debris was recruited from trees within 30 meters (96 feet) of the stream channel (*Murphy and Koski 1989*).

  In-stream large woody debris may also be recruited to 1 of the 3 stream channels from upstream channel reaches. Proposed Harvest Area III-I intersects 1 intermittent stream channel that eventually delivers seasonal flow to the West Fork, and proposed Harvest Areas III-J and III-L are jointly bordered by 1 intermittent stream channel that eventually delivers seasonal flow to the West Fork. The very low discharge of these 2 intermittent stream is unlikely to provide sufficient energy for transportation of large woody debris to downstream reaches. The intersecting reaches of these 2 first-order, intermittent tributaries, which would also have established buffers for Class I streams according to *Streamside Management Rules (1996)*, are not expected to affect sources of upstream large-woody-debris recruitment to the West Fork in any measurable or detectable way.

Therefore, Action Alternative B would not be expected to have any direct or indirect impacts to the large-woody-debris component of bull trout and westslope cutthroat trout habitat in the West Fork or Stryker and Johnson creeks beyond those described under *Existing Conditions*.

- ***Direct and Indirect Effects of Action Alternative C***

  Although Action Alternative C does not propose any harvesting in Harvest Area III, the consequences, in respect to large woody debris, would be identical to those of Action Alternative B. Therefore, the direct and indirect effects of Action Alternative C to the large-woody-debris component of bull trout and westslope cutthroat trout habitat would be expected to be the same as those described for Action Alternative B.

~ **Riparian Zone**

- ***Direct and Indirect Effects of No-Action Alternative A***

  No-Action Alternative A would not be expected to have any direct or indirect impacts to the riparian-zone component of bull trout and westslope cutthroat trout habitat in the West Fork or Stryker or Johnson creeks beyond those described under *Existing Conditions*.

- ***Direct and Indirect Effects of Action Alternative B***

  The manner in which the riparian zone affects bull trout and westslope cutthroat trout habitat through large-woody-debris recruitment to the stream channel is described under *Large Woody Debris* (previous heading). In that section, the effective riparian zone is described as varying between 81 and 93 feet along the West Fork and Stryker and Johnson creeks. Since a 100-foot no-harvest buffer would be established between these 3 streams and the associated proposed harvest areas in Action Alternative B, the riparian-zone function associated with these 3 stream channels is not expected to be affected by any of the proposed harvest areas.

  Therefore, Action Alternative B would not be expected to have any direct or indirect impacts to the riparian-zone component of bull trout and westslope cutthroat trout habitat in the West Fork or Stryker or Johnson creeks beyond those described under *EXISTING CONDITIONS*.

- ***Direct and Indirect Effects of Action Alternative C***

  The direct and indirect environmental effects to the riparian-zone component of bull trout and westslope cutthroat trout habitat for Action Alternative C would be expected to be the same as those described for Action Alternative B.

~ **Stream Temperature**

- ***Direct and Indirect Effects of No-Action Alternative A***

  No-Action Alternative A would not be expected to have any direct or indirect impacts to the stream-temperature component of bull trout and westslope cutthroat trout habitat in the West Fork or Stryker or Johnson creeks beyond those described under *EXISTGING CONDITIONS*.

- ***Direct and Indirect Effects of Action Alternative B***

  Direct solar radiation is the primary mechanism affecting positive changes in stream temperature throughout the project area. Increases in stream temperature can then, consequently, occur through the loss of riparian vegetation,

which intercepts solar radiation. The amount of riparian vegetation intercepting solar radiation, or stream shading, depends on many factors, such as width of the stream channel, site-potential tree height of dominant and co-dominant riparian tree species, riparian tree density, and stream azimuth. Nonetheless, studies with no-harvest riparian buffers of 30 meters (96 feet) in managed, forested watersheds have demonstrated levels of stream shading equivalent to unlogged, forested watersheds (*Beschta et al 1987, Castelle and Johnson 2000 citing others.*) A similar study has found the same results with a 100-foot no-harvest buffer (*Brown and Krygier 1970*). Since a no-harvest buffer of 100 feet would be established between the West Fork and Stryker and Johnson creeks and the associated proposed harvest areas in Action Alternative B, stream temperatures associated with these 3 stream channels are not expected to be affected by any of the proposed harvest areas.

Tributaries to streams can have an affect on (downstream) stream temperatures that is proportional to the discharge of the tributary. Proposed Harvest Area III-I intersects an intermittent stream channel that eventually delivers seasonal flow to the West Fork, and proposed Harvest Areas III-J and III-L are jointly bordered by an intermittent stream channel that eventually delivers seasonal flow to the West Fork. The intersecting reaches of these 2 first-order, intermittent tributaries would have established buffers for Class I streams according to *Streamside Management Rules (1996)*, which have been shown to have a statistically insignificant effect on stream temperatures in preliminary studies (*Sugden and Steiner 2003*). As these streams also provide only low, seasonally intermittent discharges to higher-order streams, no measurable or detectable changes in stream temperature would be expected in the West Fork due to Action Alternative B.

Therefore, Action Alternative B would not be expected to have any direct or indirect impacts to the stream-temperature component of bull trout and westslope cutthroat trout habitat in the West Fork or Stryker and Johnson creeks beyond those described under *Existing Conditions*.

- ***Direct and Indirect Effects of Action Alternative C***

  Although Action Alternative C does not propose any harvesting in Harvest Area III, the consequences in respect to stream temperature would be identical to those of Action Alternative B. Therefore, direct and indirect environmental effects to the stream-temperature component of bull trout and westslope cutthroat trout habitat as a result of the selection of Action Alternative C are expected to be the same as those described for Action Alternative B.

~ **Connectivity**

- ***Direct and Indirect Effects of No-Action Alternative A***

  No-Action Alternative A would not be expected to have any direct or indirect impacts to the connectivity component of bull trout and westslope cutthroat trout habitat in the West Fork or Stryker or Johnson creeks beyond those described under *EXISTING CONDITIONS*.

- ***Direct and Indirect Effects of Action Alternative B***

  As part of Action Alternative B, the bridge crossing the West Fork in Section 29, T34N, R23W, would be replaced with a new 70-foot steel bridge. The new structure would be expected to provide naturally occurring levels of connectivity to all life stages of bull trout and westslope cutthroat trout.

  Therefore, Action Alternative B would not be expected to have any direct or indirect impacts to the connectivity component of bull trout and westslope cutthroat trout habitat in the West Fork or Stryker and Johnson creeks beyond those described under *Existing Conditions*.

- ***Direct and Indirect Effects of Action Alternative C***

  Direct and indirect effects to the connectivity component of bull trout and westslope cutthroat trout habitat as a result of the selection of Action Alternative C are expected to be the same as those described for Action Alternative B.

CUMULATIVE EFFECTS FOR THE WEST FORK, STRYKER CREEK, AND JOHNSON CREEK

- ***Cumulative Effects of No-Action Alternative A***

  Action Alternative A would not be expected to have any cumulative impacts to bull trout and westslope cutthroat trout in the West Fork and Stryker and Johnson creeks.

- ***Cumulative Effects of Action Alternative B***

  Cumulative impacts are those collective impacts on the human environment of the proposed action when considered in conjunction with other past, present, and future actions related to the proposed action by location or generic type (*75-1-220, MCA*).

  The direct, indirect, and collective impacts of past- and present-related actions associated with bull trout and westslope cutthroat trout populations and habitat in the project area for all 3 specific streams are described throughout the *EXISTING CONDITIONS* section. These existing impacts to bull trout and westslope cutthroat trout described earlier range from low to moderate in the West Fork and Johnson Creek and low in Stryker Creek.

  There are no known future activities related to the proposed action by location or generic type.

  As described in the *Direct and Indirect Effects of Action Alternative B*, the actions associated with proposed Action Alternative B would have impacts to bull trout and westslope cutthroat trout that range from negligible to net positive. The assessment of the proposed actions on bull trout and westslope cutthroat trout populations (presence and genetics) and bull trout and westslope cutthroat trout habitat variables (flow regime, sediment, channel form, large woody debris, riparian-zone function, stream temperature, and connectivity) summarily indicate that no adverse negative impacts would likely be associated with Action Alternative B. Consequently, as a result of the selection of Action Alternative B, no foreseeable, adverse cumulative impacts to bull trout and westslope cutthroat trout in the West Fork and Stryker and Johnson creeks would be expected.

- ***Cumulative Effects of Action Alternative C***

  Cumulative impacts are those collective impacts on the human environment of the proposed action when considered in conjunction with other past, present, and future actions related to the proposed action by location or generic type (75-1-220, MCA).

  The direct, indirect, and collective impacts of past- and present-related actions associated with bull trout and westslope cutthroat trout populations and habitat in the project area are described throughout the EXISTING CONDITIONS section for all 3 specific streams. Those existing impacts to bull trout and westslope cutthroat trout, described earlier, range from low to moderate in the West Fork and Johnson Creek and low in Stryker Creek.

  There are no known future-related activities associated to the proposed action by location or generic type.

  As described in Direct and Indirect Effects of Action Alternative C, the actions associated with proposed Action Alternative C would have impacts to bull trout and westslope cutthroat trout that range from negligible to net positive. The assessment of the proposed actions on bull trout and westslope cutthroat trout populations (presence and genetics) and bull trout and westslope cutthroat trout habitat variables (flow regime, sediment, channel form, large woody debris, riparian-zone function, stream temperature, and connectivity) summarily indicate no adverse negative impacts would likely be associated with Action Alternative C. Consequently, as a result of the selection of Action Alternative C, no foreseeable, adverse cumulative impacts to bull trout and westslope cutthroat trout in the West Fork or Stryker or Johnson creeks would be expected beyond those described under *EXISTING CONDITIONS*.

APPENDIX F
WILDLIFE ANALYSIS

INTRODUCTION

The discussion in this section pertains to wildlife species and their habitat in the existing environment and changes to that environment due to each alternative.

During the initial scoping, the following issues were expressed regarding the effects of the proposed project:

- Timber harvesting and road use could reduce habitat security of areas for large mammals.
- Timber harvesting and road use could cause fragmentation.

In addition to the above issues, the analyses below discuss other environmental effects of the alternatives to the wildlife resource.

This discussion occurs at 2 scales. The project area includes DNRC-managed lands within Sections 18 through 21 and 28 through 34 in T34N, R23W, and Section 13 in T34N, R24W. Full descriptions of the project area and proposed harvest areas are presented in *CHAPTER II - ALTERNATIVES* (*TABLE II-1 - SILVICULTURAL TREATMENTS BY HARVEST AREA NUMBER FOR ACTION ALTERNATIVES B AND C)*. The second scale relates to the surrounding landscape for assessing cumulative effects. This scale varies according to the species being discussed, but generally approximates the size of the home range of the species in question. Under each grouping or species heading, the description for the cumulative-effects analysis area will be discussed. In the cumulative-effects analysis area, the project area and the effects are placed in a landscape context. If habitat does not exist in the project area or would not be modified by any alternative, species that use that habitat were dismissed from further analysis.

METHODS

To assess the existing condition of the project area and the surrounding landscape, a variety of techniques were used. Field visits, scientific literature, data from the SLI and Montana Natural Heritage Program, aerial photography, consultations with other professionals, and professional judgment provided information for the following discussion and effects analysis. In the effects analysis, changes in the habitat quality and quantity from the existing conditions were evaluated and explained. Specialized methodologies are discussed under the species in which they apply.

COARSE-FILTER ASSESSMENT

DNRC recognizes that it is an impossible and unnecessary task to assess an affected environment or the effects of proposed actions on all wildlife species. We assume that if landscape patterns and processes similar to those that species adapted to are maintained, then the full complement of species will be maintained across the landscape (*DNRC 1996*). This "coarse filter" approach supports diverse wildlife populations by managing for a variety of forest structures and compositions that approximate "historic conditions" across a landscape. To compare present and historical conditions across the landscape, the analysis was conducted for Stillwater State Forest using SLI data (refer to *APPENDIX B - VEGETATION ANALYSIS*) and was compared to the historical assessment compiled for the Lower Flathead Climatic Section (*Losensky 1997*).

Covertypes

The vegetation analysis indicates that covertypes changed over the past century due to the influence of fire suppression, insects and diseases, and timber harvesting. Generally, Stillwater State Forest should support more western white pine and western larch/Douglas-fir covertypes and less subalpine fir and lodgepole pine covertypes than found on average for the climatic type. All other covertypes occur near historical proportions found in the climatic section (*Losensky 1997*). Therefore, species using western white pine and western larch/Douglas-fir covertypes are presumably more likely to be found and/or be more abundant on Stillwater State Forest than on average in the climatic section. Conversely, species using subalpine fir and lodgepole pine covertypes are presumably less likely to occur or occur in lower densities on Stillwater State Forest due to the amount of habitat present, while species that use other covertypes are expected to occur near the average densities expected throughout the climatic section. However, primarily due to fire suppression, timber management, and introduced diseases, many of the stands have increased in the proportion of shade-tolerant tree species (*TABLE F-1 - PERCENTAGE OF COVERTYPES FOUND ON STILLWATER STATE FOREST AND THE CLIMATIC SECTION*). Fire suppression probably had little effect in the project area, while past timber harvesting and diseases heavily influenced the decline in shade-intolerant tree species. The changes presumably reduce the abundance of species that use open, shade-intolerant forested habitat, while favoring species using dense, closed-canopy habitats.

Patch Size and Interior Habitats

Species that are hesitant to cross broad expanses without forest cover, or those that depend upon interior forest conditions, can be sensitive to the amount and spatial configuration of appropriate habitat. Therefore, patch size and juxtaposition can influence habitat quality and population dynamics for some species. Some species are adapted to thrive near patch edges, while others are adversely affected by the presence of edge or by the presence of other animals that prosper in edge habitats.

TABLE F-1 - PERCENTAGE OF COVERTYPES FOUND ON STILLWATER STATE FOREST AND THE 333C CLIMATIC SECTION

COVERTYPE	PERCENT CLIMATIC SECTION (LOSENSKY 1997)	PERCENT OF COVERTYPES ON THE STILLWATER STATE FOREST EXPECTED UNDER HISTORIC CONDITIONS	PERCENT OF COVERTYPES ON THE STILLWATER STATE FOREST EXISTING COVERTYPES CURRENTLY
Douglas-fir	<1	2	2
Lodgepole pine	27	11	11
Mixed conifer[1] (spruce-fir)[2]	6	8	27
Nonforest[1] (wheat-fescue)[2]	Trace	2	2
Other types	Trace	Trace	Trace
Ponderosa pine	1	1	1
Subalpine fir	36	20	26
Western larch/ Douglas-fir	28	45	26
Western white pine	1	11	3

[1] DNRC classification
[2] Losensky (1997) classification

A "patch" is defined as a unit of habitat with broadly similar age and structural characteristics (primarily associated with forest or nonforest cover). For this analysis, forested habitats provided the basis for patch, interior-habitat, and edge-habitat analyses. Forested habitats were defined as stands greater than 40 years old (pole- to sawtimber-sized stands) with a canopy cover of 40 percent or more. Interior forested habitat is defined as an area that is not affected by the adjacent stand and retains similar climatic conditions. Conversely, edge is defined as the contact zone between 2 different types of habitat. For this analysis, the first 300 feet of a patch was considered edge habitat; the remaining patch was considered interior forested habitat (*TABLE F-2 - EXISTING AND RESULTING FORESTED, INTERIOR, AND EDGE HABITAT ON THE UPPER WHITEFISH LAKE SUBUNIT*).

Connectivity

Connectivity of forest cover between adjacent patches is important for promoting movements of species that are hesitant to cross broad, nonforest expanses. Stands that are pole-sized or greater with crown closure greater than 40 percent can be important for providing travel cover for forest-dwelling species. Across Stillwater State Forest, connectivity is high with few isolated stands. No harvest areas are proposed in key travel areas, such as saddles or near streams (*FIGURE F-1 - FORESTED HABITATS FOUND ON THE UPPER WHITEFISH LAKE SUBUNIT*). See *Canada Lynx* and *Fisher* analyses for additional details on connectivity and travel cover.

Dead Wood

Dead wood (downed trees and snags) is an important component of the forested ecosystems. The 5 primary functions of dead wood in the forested ecosystems are to:

1) increase structural diversity,
2) alter canopy microenvironment,
3) promote biological diversity,
4) provide critical habitat for wildlife, and
5) act as a storehouse for nutrient and organic matter recycling agents (*Parks and Shaw 1996*).

This analysis focuses on the importance of dead wood as wildlife habitat and the effects of this project on those habitats.

The presence of insects and predaceous birds and mammals are important to forest management. Both insects and birds associated with snags and downed wood are suspected of controlling insects that are harmful to wood production, such as the Douglas-fir tussock moth and spruce budworm. However, when insect populations reach epidemic levels, predation is often ineffective at controlling or reducing population levels (*Torgensen 1994*). Small mammals that are associated with downed wood distribute ectomychorrhizal fungus, which is needed for seedling establishment and tree growth (*Amaranthus 1998*). Therefore, maintenance of habitats for insectivorous birds and mammals is important for long-term forest health.

Snags and logs provide reproduction, feeding, rearing, and/or

TABLE F-2 - EXISTING AND RESULTING ACRES OF FORESTED, INTERIOR, AND EDGE HABITAT ON THE UPPER WHITEFISH GRIZZLY BEAR SUBUNIT

PARAMETER	NO-ACTION ALTERNATIVE A	ACTION ALTERNATIVE B	ACTION ALTERNATIVE C
Forested habitat	21,465	20,278	20,610
Interior habitat	14,771	13,245	13,635
Edge habitat	6,694	7,033	6,975

FIGURE F-1 - EXISTING FORESTED HABITAT IN THE UPPER WHITEFISH GRIZZLY BEAR SUBUNIT

shelter structure for an array of wildlife species. Dead wood provides insects, fungus, and wood food sources for small mammals. In turn, these small mammals provide prey for predatory birds and mammals. Additionally, dead wood provides animal areas with:

- stable temperatures and moisture,
- shelter from the environment,
- lookout areas, and
- food storage sites.

Small mammals, such as red-backed voles, to large mammals, such as black bears, rely on dead wood for survival and reproduction.

The size, length, decay, and distribution of dead wood affect their capacity to provide specific habitat. Logs less than 6 feet in length tend to dry out and provide limited habitat for wildlife species. Single, scattered logs could provide lookout and travel sites for squirrels or access under the snow for weasels and other small mammals, while log piles provide habitat for weasels, hares, other small mammals, etc. Similarly, diameters, heights, and snag densities determine the snag habitat value for wildlife species. Larger, taller snags tend to provide nesting sites, while shorter snags and stumps tend to provide feeding sites for birds and mammals. Cavity-nesting birds often nest in areas where several snags are available, using individual snags as feeding or roosting sites; therefore, considering the size and distribution of these resources is important.

Snag data were collected in areas where SLI data indicated the stand might meet the old-growth definition defined by *Green et al (1992)*. These areas occurred only in Harvest Area III, which is exclusive to Action Alternative B. Mean snag densities (greater than 14 inches dbh) ranged from 0 to 16 per acre, with an average of 3.1 ($n_{(stands)} = 19$) and 3.4 ($n_{(stands)} = 3$) for stands in cool and moist and cold and moderately dry habitat types, respectively. Only 2 of the sampled stands were harvested in the past. In the harvested stands, snag densities are among the lowest encountered. Whitebark pine was the most common snag encountered (36 percent of all snags), followed by subalpine fir (30 percent), Engelmann spruce (26 percent), and Douglas-fir (8 percent). The live-tree distribution is quite different; Engelmann spruce (75 percent) represents the highest proportion of large trees (greater than 21 inches dbh), followed by subalpine fir (12 percent), Douglas-fir (9 percent), whitebark pine (3 percent), and western larch (2 percent). These trees could provide snag and coarse-woody-debris recruitment in the future. Regeneration in the project area is primarily shade-tolerant Engelmann spruce and subalpine fir. Snag densities in the other harvest areas were subjectively assessed and appear to be relatively low in density, which is expected in previously harvested stands (*Harris 1999*) and near open roads (*Bate et al. 2002*).

COARSE FILTER

Direct Effects to Coarse Filter

- ***Direct Effects of No-Action Alternative A to Coarse Filter***

  No additional displacement or disturbance of wildlife is expected in the area.

- ***Direct Effects of Action Alternatives B and C to Coarse Filter***

  Displacement and/or disturbance of wildlife species would be expected due to these alternatives. Since different species react to human disturbance differently, the extent of disruption would be related to the species in question. Generally, the amount of harvest area, associated roads, and duration of the project provides an avenue to develop a

hierarchy of potential disturbance to wildlife in the area. Both action alternatives would be implemented over a 3-year period. Action Alternative B proposes to harvest 9.5 mmbf of timber from 1,270 acres and construct 3.4 miles of new roads. Action Alternative C proposes to harvest 5.7 mmbf of timber from 938 acres and construct 3.1 miles of new roads. Due to the amount of acres and volume, Action Alternative B is expected to take longer to complete than Action Alternative C. Due to the increased area and duration of Action Alternative B, Action Alternative B is expected to produce more disturbances to wildlife species than Action Alternative C. However, the project design features would be incorporated to reduce widespread disturbance of the area (see *Grizzly Bear* analysis).

Indirect Effects to Coarse Filter Covertypes

- ***Indirect Effects of No-Action Alternative A to Covertypes***

  The stands considered for harvesting would continue to age, and the western larch/Douglas-fir covertypes would convert to mixed-conifer or subalpine fir covertypes. Where mixed-conifer and subalpine fir covertypes currently exist, these covertypes would be retained, but these stands would maintain or increase their canopy closure, shading out understory plants and shade-intolerant tree seedlings. In the long-term, species that use the more open stands and/or shade-intolerant tree species, would be negatively affected due to the loss of habitat, while species that use late-successional forest structure, would benefit by an increase in habitat.

- ***Indirect Effects of Action Alternative B to Covertypes***

  Harvesting under this alternative would convert most stands to younger age classes, but would not necessarily change covertypes. On 138 acres, harvesting would promote more historic covertype representation. On the remaining 1,130 acres, the current covertype would be retained; however, shade-intolerant species, such as western larch and western white pine, would be planted in regeneration-harvest areas to reintroduce or increase their representation in the future stand. DNRC would rely on natural regeneration of whitebark pine to increase or maintain this species in the future stand. These changes would favor wildlife species that use the more-open canopies and shade-intolerant tree species at the expense of wildlife species associated with closed-canopy, shade-tolerant tree species. If whitebark pine successfully regenerates, species such as Clarke's nutcrackers, grizzly bears, squirrels, etc., would benefit from an increase in key food sources.

- ***Indirect Effects of Action Alternative C to Covertypes***

  Harvesting under this alternative would convert most stands to younger age classes, but not necessarily change covertypes. On 46 acres, harvesting would promote more historic covertype representation. On the remaining 892 acres, the covertype would be retained; however, shade-intolerant species, such as western larch and western white pine would be planted in regeneration-harvest areas to reintroduce or increase their representation in the future stand. These changes would favor wildlife species that use more-open canopies and shade-intolerant tree species at the expense of

wildlife species associated with closed-canopy, shade-tolerant tree species. Whitebark pine regeneration is not expected in any of these harvest areas.

Patch Size and Interior and Edge Habitats

- ***Indirect Effects of No-Action Alternative A to Patch Size and Interior and Edge Habitats***

  Patch size and interior and edge habitats would not change in the near term. Through time, forested patch size and interior habitat are expected to increase, while edge habitat would be expected to decrease. These conditions would favor wildlife species that prefer dense, mature forests at the expense of wildlife species that use nonforest, open-canopied, or edge habitats.

- ***Indirect Effects of Action Alternative B to Patch Size and Interior and Edge Habitats***

  Forested habitat would decrease by 1,187 acres and interior forested habitat would decrease by 1,526 acres, while edge habitat would increase by 339 acres in the Upper Whitefish Grizzly Bear Subunit (*TABLE F-2 - EXISTING AND RESULTING ACRES OF FORESTED, INTERIOR, AND EDGE HABITAT ON UPPER WHITEFISH GRIZZLY BEAR SUBUNIT)*. Habitat for species that use forested and interior habitat would decrease, while species that use edge and regeneration or unforested habitats would be favored.

- ***Indirect Effects of Action Alternative C to Patch Size and Interior and Edge Habitats***

  Forested habitat would decrease by 855 acres and interior forested habitat would decrease by 1,136 acres, while edge habitat would increase by 281 acres in the Upper Whitefish Grizzly Bear Subunit (*TABLE F-2 - EXISTING AND RESULTING FORESTED, INTERIOR, AND EDGE HABITAT ON UPPER WHITEFISH GRIZZLY BEAR SUBUNIT*). Habitat for species that use forested and interior habitat would decrease, while species that use edge and regeneration or unforested habitats would be favored. These effects are intermediate between No-Action Alternative A and Action Alternative B.

Connectivity

- ***Indirect Effects of No-Action Alternative A to Connectivity***

  No change in forest connectivity is expected. Over time, forest connectivity would be expected to increase due to the succession of early seral stands and sparse stands. The increase in connectivity would benefit species that depend on dense interconnected forest by providing movement corridors and other habitats within the project area.

- ***Indirect Effects Common to Action Alternatives B and C to Connectivity***

  Timber harvesting under these alternatives does not substantially alter connectivity. In both alternatives, regeneration harvests would not result in barriers to forest dwelling species (*FIGURE F-2 - FORESTED HABITAT IN THE UPPER WHITEFISH GRIZZLY BEAR SUBUNIT UNDER EITHER ALTERNATIVE*). However, Action Alternative B narrows the connectivity corridor along the West Fork to approximately 500 feet. Under both alternatives, substantial effects to connectivity are not expected; therefore, any effects are expected to be negligible.

Dead Wood

- ***Direct and Indirect Effects of No-Action Alternative A to Dead Wood***

  No changes in dead-wood resources would occur. Tree mortality, especially shade-tolerant tree species, could increase due to insects and diseases or other natural events. This situation would benefit species that use dead-wood resources in the short

FIGURE F-2—FORESTED HABITAT IN THE UPPER WHITEFISH GRIZZLY BEAR SUBUNIT UNDER EITHER ALTERNATIVE

term; however, because of the current lack of shade-intolerant tree species in the longer term, reductions in dead wood, especially shade-intolerant tree species, could occur.

- ***Direct and Indirect Effects Common to Action Alternatives B and C to Dead Wood***

  Under both alternatives, dead-wood resources would be targeted to be retained in the harvest areas. Harvesting could remove recently dead trees that are merchantable, but would attempt to retain most of the cull material. Based on data collected by the USFS on Lolo National Forest, an estimate of snag loss during harvesting activities ranged from 50 to 100 percent (*Hillis 1993*). On a recent DNRC timber sale where all snags greater than 14 inches were to be retained; 60 percent were standing following harvesting; however, when all snags were considered, only 35 percent were left standing. A majority of the loss of snags occurred in the medium-size class, with retention of the larger snags appearing more successful. Therefore, nearly one-half of the snags, mostly small to medium sized, planned for retention in the area could succumb to operational or safety-related felling. These losses are expected to be larger in the cable-yarding harvest areas and exasperated if prescribed fire is used for site preparation.

  In each harvest area, a minimum of 1 snag and 1 snag-recruitment trees over 21 inches dbh would be retained (*ARM 36.11.411*). If snags planned for retention were felled for safety concerns, these trees/snags would be left on site to provide feeding substrate and habitat structure for wildlife species. In all harvest areas, decreases in feeding and nesting sites might occur due to the reduction in snags, while some ground structure and foraging sites could be removed by the harvesting and crushing of downed trees. Harvesting is expected to reduce the densities of small to medium-sized snags; therefore, these alternatives are likely to affect smaller cavity-nesting species and their associated secondary cavity species. However, retention of dominant trees, existing dead wood, and untreated piles of cull logs is expected to provide habitat for species associated with large dead wood in the short and long term. More dead wood habitat would be retained under Action Alternative C than under Action Alternative B. The loss of dead-wood structure could reduce insectivorous wildlife species, which could result in increased populations of forest pests (*Torgenson 1994*) and could inhibit regeneration by reducing distribution of ectomychorrhizal fungus distributed by small mammal (*Amaranthus 1998*). However, not all dead wood would be removed from the stand, thereby providing some habitat for these species. The scale of the effects to these species is unknown, but is expected to be related to the reduction in dead-wood habitat.

CUMULATIVE EFFECTS - COARSE FILTER

Cumulative Effects to Covertype and Age Class

- ***Cumulative Effects of No-Action Alternative A to Covertype and Age Class***

  Covertypes would continue to convert from shade-intolerant to shade-tolerant covertypes, and stands in older age classes would continue to increase. Where shade-tolerant covertypes are present, shade-intolerant tree densities would continue to decline. This situation would affect wildlife species using the area by decreasing habitat diversity in the area and favoring

species associated with late-succession, shade-intolerant tree species.

- ***Cumulative Effects Common to Action Alternatives B and C to Covertype and Age Class***

  Efforts under both action alternatives would be made to convert stands to more closely reflect the historic conditions outlined in *Losensky (1997)*. Under Action Alternative B, conversion would occur through the thinning of shade-tolerant species and regeneration harvesting. The harvesting would result in more closely reflecting historic covertypes and age classes. This alternative would benefit early successional species at the expense of mid- to later-successional species. The treatments are expected to increase the growth of retained trees, thereby decreasing the amount of time before large trees are available in these stands. These alternatives are expected to benefit native wildlife species by reproducing habitats to which the species are adapted.

Cumulative Effects to Patch Size, Interior and Edge Habitats, and Connectivity

Adjacent USFS lands are not expected to be harvested, thereby increasing forested habitat and patch size in those areas. The effects discussed under the indirect effects above would be cumulative to the conditions occurring on adjacent lands in the area.

Cumulative Effects to Dead-Wood Resources

Reductions in dead-wood resources would be cumulative to past timber and salvage harvests. However, in these areas, mitigations to provide dead-wood habitats are incorporated in all these projects. So, although dead-wood resources would be reduced in the cumulative effects area, retention of specific snags and downed trees would continue to contribute habitat, albeit at a lower density in the short-term, for species that use dead-wood resources.

FINE FILTER

In the fine-filter analysis, individual species of concern are evaluated. These species include wildlife species listed under the Endangered Species Act, species listed as sensitive by DNRC (*ARM 36.11.436(6)*), and species managed as big game by DFWP.

THREATENED AND ENDANGERED SPECIES

➢ Bald Eagle

The bald eagle is classified as "threatened" and is protected under the Endangered Species Act. Strategies to protect the bald eagle are outlined in the Pacific States Bald Eagle Recovery Plan (*USFWS 1986*) and the Montana Bald Eagle Management Plan (*Montana Bald Eagle Working Group 1994*). Management direction involves identifying and protecting nesting, feeding, perching, roosting, and wintering/migration areas (*USFWS 1986, Montana Bald Eagle Working Group, 1994*). For the nesting territory at Upper Whitefish Lake, *Paige (1997)* developed site-specific management guidelines that will be followed in this project.

Bald eagles prefer multistoried nesting habitats with 40- to 70-percent canopy cover with emergent trees within topographic line-of-sight to an associated water source with an adequate food supply. The emergent trees and/or snags need to be large enough (more than 25 inches dbh) to support nesting or perching eagles. Additionally, eagles prefer cottonwood, Douglas-fir, and ponderosa pine trees *(Wright and Escano 1986)*. In western Montana, eagles also use western larch and Engelmann spruce.

Eagles nest south of Upper Whitefish Lake. *Paige (1997)* defined the nest area to include the south shoreline of the lake to West Fork Road; the primary use area includes the nest area and extends approximately 1 mile to the north. The home range of these eagles extends north from Swede Creek to Nasukoin Lake and east from the divide between Swift Creek and the West Fork drainages to Hay Lake (*FIGURE F-3 - UPPER WHITEFISH BALD EAGLE TERRITORY*). The eagles return to their breeding territory in February and, if successful raising eaglets, will inhabit the nest area through August. No proposed harvest areas occur within the nest or primary-use area. However, haul routes intersect the nest and primary-use area. The West Fork Road (open road) borders the south boundary of the nest and primary-use area, while the Whitefish Saddle Road (restricted road) cuts through the primary-use area.

To assess cumulative effects to bald eagles, the bald eagle territory home range was used. This area includes DNRC (approximately 33 percent) and National Forest System Lands (approximately 66 percent). Harvest Areas I, II-A, and II-C fall into the bald eagle's home range.

Direct Effects

- ***Direct Effects of No-Action Alternative A to Bald Eagles***

  No additional direct effects to nesting or wintering bald eagles would be expected.

- ***Direct Effects Common to Action Alternative B and C to Bald Eagles***

  No harvesting would occur in the nest or primary-use area. However, hauling through the primary-use area and along the boundary of the nest-site area would occur. To limit disturbance to nesting eagles, Harvest Areas I and II-A would not be harvested during the eagle nesting season (February 1 through August 15) unless the territory is determined to be unoccupied. If needed, logs could be loaded and hauled (but not cut, skidded, or processed) from Harvest Area II-A during the nesting season because the harvest area is along an open road. Loading and hauling would be a short-term disturbance consistent with disturbance found along open roads. However, if this activity is determined to be too disruptive to the nesting eagles, the hauling operation would be discontinued immediately and would start again after August 15. With these mitigation measures in place, no additional disturbance effects are expected.

Indirect Effects

- ***Indirect Effects of No-Action Alternative A to Bald Eagles***

  Timber stands that presently provide bald eagle habitat would continue to increase in density and proportion of shade-tolerant tree species, while decreasing in growth rates. Additionally, snags would continue to develop. Barring any natural disturbance, shade-intolerant trees would not regenerate over time. Existing younger stands would continue to grow and produce the structure needed by eagles, but at a slower rate due to dense stocking. Under this alternative, the quality of eagle nesting habitat would decrease as canopy cover increases above 70 percent (*Montana Bald Eagle Working Group 1991*). The potential of these effects limiting nest success of this breeding pair is low.

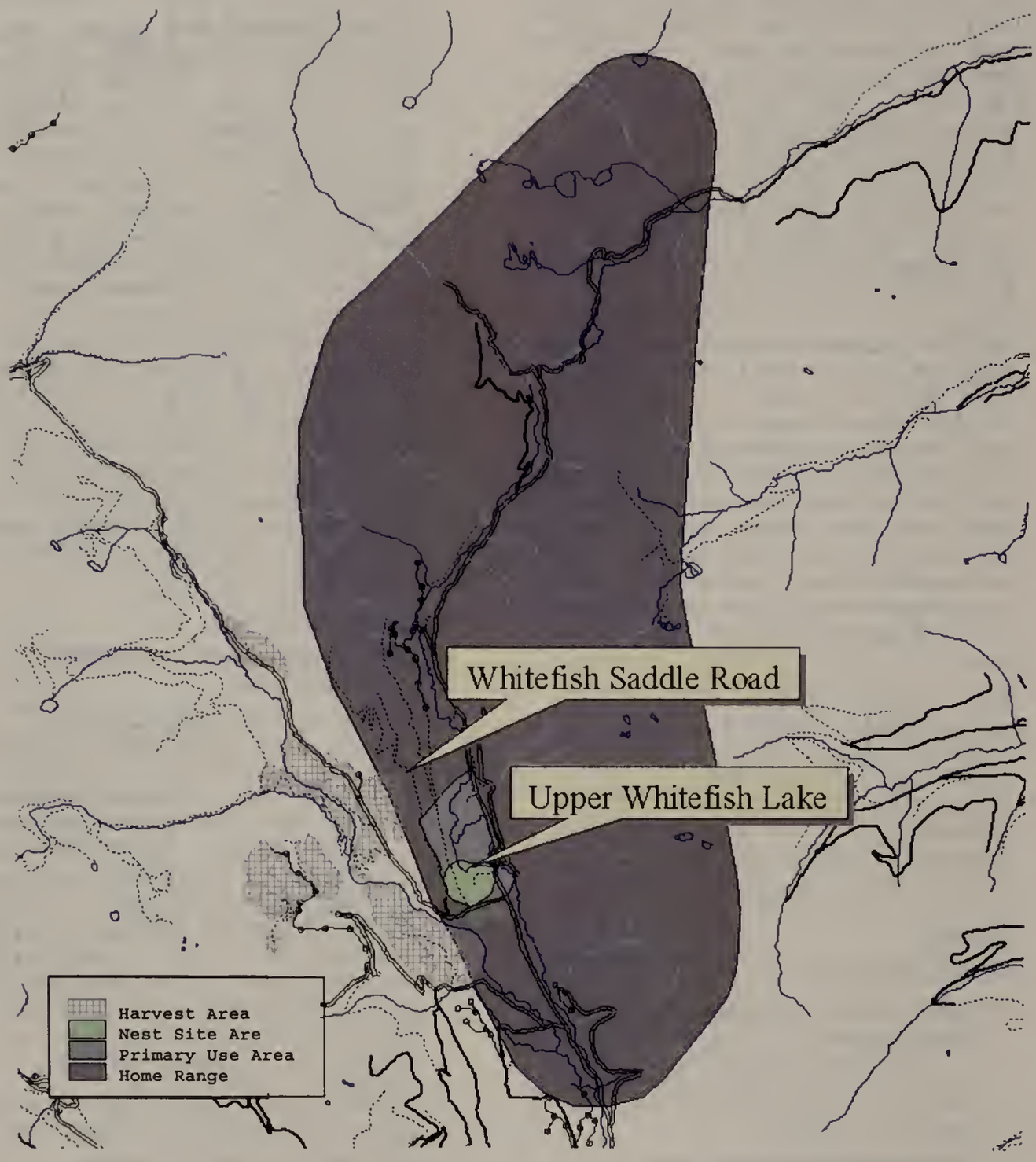


FIGURE F-3 - UPPER WHITEFISH BALD EAGLE TERRITORY

- ***Indirect Effects to Bald Eagles Common to Action Alternative B and C***

  No habitat modifications would occur in the nest site or primary-use area under these alternatives. Therefore, the effects discussed above in the No-Action Alternative are expected to occur in these areas.

Cumulative Effects

- ***Cumulative Effects of No-Action Alternative A to Bald Eagles***

  Under this alternative, no additional disturbance or habitat modification would occur in the analysis area. No other projects are proposed in the home-range area.

- ***Cumulative Effects to Bald Eagles Common to Action Alternative B and C***

  This alternative would result in treatment of 119 acres of timber within the 17,520-acre home range associated with this territory. None of these stands are located in a landscape position (outside line-of-sight of an associated waterbody) where they provide potential bald eagle nesting habitat. In both Harvest Areas II-A and II-C, regeneration and a group-select harvest prescriptions would be implemented. These treatments would open the overstory canopy, which would increase eagle access to small mammal prey, while retaining dominant trees scattered throughout the harvest area or in groups. Over time, these harvest areas would develop a multilevel canopy. These conversions are expected to be neutral to positive. However, harvests in Harvest Area II-A would decrease visual screening between the open West Fork Road and the harvest area, thereby offsetting any benefit realized by reducing canopy cover. Otherwise, no other projects are planned in the cumulative-effects analysis area. The effects of these habitat alterations are expected to be neutral to slightly positive, but are not expected to change the reproductive success rate of this nesting pair.

➢ Canada Lynx

Canada lynx are listed as "threatened" under the Endangered Species Act. Currently, no recovery plan exists for Canada lynx. Several reports have been written to summarize the research on lynx and develop a conservation strategy (*Ruediger et al 2000*).

Lynx are associated with subalpine fir forests, generally between 4,000 and 7,000 feet in elevation, in western Montana (*Ruediger et al 2000*). Lynx habitat in western Montana consists primarily of young coniferous forest with plentiful snowshoe hares, stands with abundant coarse woody debris for denning and cover for kittens, and densely forested cover for travel and security. Additionally, the mature forests provide habitat for red squirrels, an alternative prey source. These conditions are found in a variety of habitat types, particularly within the subalpine fir series (*Pfister et al 1977*).

To assess lynx habitat, DNRC SLI data were used to map specific habitat classes used by lynx. These areas were considered *lynx habitat* (*ARM 36.11.403(40)*). Other parameters (stand age, canopy cover, amount of coarse woody debris) were used in modeling the availability of specific types of lynx habitat in the area (i.e. denning, forage, other, temporarily not available) (*ARM 36.11.435(2)*).

Based on field reconnaissance and SLI modeling, denning habitat is not expected to be affected, while all harvest areas occur in general

or foraging habitat. The current conditions allow lynx to move through the project area and the proposed harvest areas. All stands proposed for harvesting likely provide red squirrel habitat, and stands or portion of stands with thick understories likely provide snowshoe hare habitat.

Cumulative effects were analyzed for lands in the Upper Whitefish Grizzly Bear Subunit. Based on the above analysis, lynx habitat comprised approximately 26,866 acres, nearly the entire DNRC ownership in the Upper Whitefish Subunit. Of these acres, 915 acres are modeled as denning habitat. The denning habitat component is difficult to model because lynx can den in small patches of downed wood within a large stand. The SLI is designed to identify general stand conditions and does not capture small dense patches of downed woody material; therefore, it is likely that more denning habitat occurs on the landscape than the model predicts. Other classifications used in the modeling effort appear more predictable.

Direct Effects

- ***Direct Effects of No-Action Alternative A to Canada Lynx***
  No additional activities would occur; therefore, no direct effects would be expected.

- ***Direct Effects Common to Action Alternatives B and C to Canada Lynx***

  Some disturbance of lynx could occur in areas with adequate cover for lynx to travel through. However, lynx appear to be relatively tolerant of human presence and road use (Mowat et al 2000); therefore, no substantial direct effects would be expected. A slight potential increase for mortality due to road traffic on gated and/or new roads would be possible, though the risk of this occurring would likely be extremely small. Lynx do not appear to avoid roads at low traffic volumes (Ruediger 2000), so increased logging traffic on open and gated roads is not expected to displace or increase the energetic cost of individual lynx. The risks are higher under Action Alternative B, than Action Alternative C, but both alternatives are expected to result in very minor risks of negative direct effects.

Indirect Effects

- ***Indirect Effects of No-Action Alternative A to Canada Lynx***

  Under No-Action Alternative A, lynx would continue to use the project area similarly in the short-term because no lynx habitat would be modified under this alternative. In the longer-term (barring natural disturbances), stands would continue to age and increase in the coarse woody debris needed for denning and security cover. Regenerating harvest areas would mature and reduce habitat quality for snowshoe hares, potentially resulting in decreased primary prey availability for lynx. As these stands mature, habitat for red squirrels would increase, somewhat lessening the loss of prey. However, a diet of red squirrels might not provide the nutrients needed for the successful reproduction and rearing of kittens (*Koehler 1990*). Therefore, in the short term, no effects to lynx are expected. In the longer-term without disturbance, denning habitat is expected to increase, but foraging opportunities are expected to decrease.

- ***Indirect Effects of Action Alternative B to Canada Lynx***

  Lynx habitat would be modified on 1,270 acres. A regeneration harvest prescription would be implemented on 1,198 acres; a commercial thin prescription would occur on the remaining 72 acres. Regeneration harvests would render the harvest area temporarily unsuitable for lynx. Over time, if the harvest areas regenerate to a dense stocking of young trees, snowshoe hare populations in these areas are expected to increase, thereby providing an increase in lynx foraging opportunities. Due to the steep slopes and shrub competition, the harvest areas specific to this alternative (Harvest Area III) might not regenerate successfully enough to provide young foraging habitat. Past harvesting in adjacent areas show sparse regeneration over the past 20 to 30 years. In the proposed regeneration harvest areas (332 acres), tree density is not expected to meet young foraging habitat criteria, however, the shrub component could provide summer cover for snowshoe hares. Therefore, lynx use of these areas is expected to be limited until the regenerating canopy exceeds 40 percent canopy closure, resulting in marginal habitat in 40 to 80 years. If these stands do not regenerate successfully, lynx habitat would be removed on 332 acres for a long period of time. In Harvest Area I, where a commercial-thin treatment is proposed, harvesting would remove trees that could lead to red squirrel population declines to an unknown degree due to the removal of cone-producing trees (*Pearson 1999*). However, canopy cover would be retained above 40 percent; therefore, the potential for lynx to use or move through this harvest area is expected to continue. Additionally, several slash piles throughout Harvest Area II would be retained following harvesting to potentially provide denning sites near future high quality foraging areas. The regeneration harvest areas and associated piles of cull logs are not expected to be used until dense regeneration occurs. In the short-term, available lynx habitat would decline. As stands regenerate, foraging and denning habitats are expected to increase.

- ***Indirect Effects of Action Alternative C to Canada Lynx***

  The effects discussed above would apply to harvest areas proposed under this alternative. However, the 332 acres discussed above would not be harvested. This alternative is expected to result in the benefits discussed above without the potential long-term loss of habitat on 332 acres in Harvest Area III.

Cumulative Effects

- ***Cumulative Effects of the No-Action Alternative A to Canada Lynx***

  No habitat would be modified. In time, denning habitat would develop on much of the area at the expense of young forage. Snowshoe hare populations would remain relatively stable, but possibly at low densities due to the lack of the temporal high-density, young successional habitats. Under these alternatives, barring any disturbance, forage availability would decrease, while denning habitat would increase.

- ***Cumulative Effects of Action Alternative B to Canada Lynx***

  Under this alternative, 1,198 acres of lynx habitat in the Upper Whitefish Subunit would be converted to 'unsuitable' for 10

to 20 years. The conversion of habitat would be cumulative to other past harvesting on State land; some harvest areas have not fully regenerated in 20 to 30 years. Of this proposed alternative, 332 acres are in areas similar to those that have not regenerated in the past 2 to 3 decades. In the other harvest areas, young foraging habitat is expected to develop. Additionally, denning structure (piles of cull logs) would be left following harvesting, which could increase denning habitat in this subunit.

- ***Cumulative Effects of Action Alternative C to Canada Lynx***

  Under this alternative, 866 acres of lynx habitat in the Upper Whitefish Subunit would be converted to *unsuitable* for 10 to 20 years. All of the proposed harvest areas in this alternative are expected to regenerate successfully; therefore, young foraging habitat is expected to develop in 10 to 20 years. Additionally, denning structure (piles of cull logs) would be left following harvesting, which could increase denning habitat in this subunit. This alternative is expected to impact lynx to a minor degree in the short-term, with greater long-term benefits.

➢ Gray Wolf

The gray wolf is listed as "threatened" under the Endangered Species Act. The *Northern Rocky Mountain Wolf Recovery Plan* defines 3 recovery zones (*USFWS 1987*). The proposed project is in the Northwest Montana Recovery Zone. The 3 recovery zones met the recovery standards for the last 2 years and are expected to meet the 10 packs per recovery area this year, initiating the delisting process.

The wolf is a wide-ranging, mobile species. Adequate habitat for wolves consists of adequate vulnerable prey and minimal human disturbance, especially at den and/or rendezvous sites. Primary prey species in northwest Montana are white-tailed deer, elk, moose, and mule deer. Distribution of wolves is strongly associated with white-tailed deer winter ranges. Wolves in northwest Montana typically den in late April. Wolves choose elevated areas in gentle terrain near a water source (valley bottoms), close to meadows or other openings, and near big game wintering areas for dens and rendezvous sites.

The project area contains elk and white-tailed and mule deer nonwinter ranges, which could provide prey for wolves. However, due to the high elevation, denning and rendezvous sites are not expected and harvesting activities would not occur in spring when wolves and their pups are sensitive to human disturbance. Wolf use of the area is expected to be transitory or sporadic; therefore, this project is not expected to affect gray wolves, and this species was dropped from further analysis for this project

➢ Grizzly Bear

Grizzly bears are listed as "threatened" under the Endangered Species Act. The Grizzly Bear Recovery Plan defines 6 recovery areas (*USFWS 1993*). This project is proposed in grizzly bear habitat in the North Continental Divide Ecosystem Recovery Area. The North Continental Divide Ecosystem is divided into subunits. Each subunit approximates the size of a home range for a female bear and is separated from other subunits based on landscape features. This project is proposed in the Upper Whitefish Subunit.

The project area provides year-round habitat for grizzly bears. During the spring, bears search for winter-killed big game and lush green vegetation, especially in avalanche chutes. During the summer, bears seek lush green vegetation typically found in riparian areas. In late summer and into autumn, bears switch primarily to a berry diet. The project area contains high elevation, relatively flat basins bounded by steep slopes with numerous avalanche chutes and riparian habitats. Repeated spring observations indicate that grizzly bears could be migrating through the project area between denning sites and spring habitat. During summer and autumn, the basins and riparian habitats in the project area provide high quality habitat for bears. This project could affect grizzly bears directly through increased road traffic, noise, and human activity indicated by changes in road densities, and indirectly by altering the amount and location of hiding cover and forage resources.

The cumulative effects analysis was conducted using the Upper Whitefish Subunit. This subunit is comprised of 84 percent DNRC- and 16 percent USFS-managed lands. This subunit receives a high amount of recreational activities, especially around Upper Whitefish Lake. Recreational use varies by season and includes snowmobiling, ice fishing, camping, fishing, ATV riding, firewood cutting, etc. During the nondenning season, these activities are generally confined to Upper Whitefish Lake, the surrounding area, and along open roads.

Access management is a major factor in managing grizzly bear habitat. Several open roads are in the subunit (Upper Whitefish, West Fork, Swede, Stryker Ridge, and Johnson) and the seasonally restricted (March 15 through June 30) Antice Road. Other roads in the area are restricted year-round with gates or berms (*FIGURE F-4 - EXISTING ROADS AND ROAD MANAGEMENT IN THE UPPER WHITEFISH GRIZZLY BEAR SUBUNIT*). To measure disturbance associated with open and total roads, a moving-windows analysis (*Ake 1994*) was used. Additionally, areas that are 500 meters from open or gated roads were defined as potential security core habitat. The road-management scenario in this subunit yields precise-open-road (POR) density (greater than 1 mile per square mile) of 31.8 percent; precise-total-road (PTR) density (greater than 2 miles per square mile) of 33.8 percent; and 51.6 percent of potential-security-core area. DNRC committed to design projects not to exceed the POR or decrease the amount of potential security core realized in 1996 baseline (*ARM 36.11.432 [1][c and d]*), unless approved by the Forest Management Bureau Chief (*ARM 36.11.432 [c][ii]* and *[d][i]*). In 1996, the POR was 32.9 percent, PTR was 41.2 percent (no commitment under *ARM*), and 43.8 percent was security core (*TABLE F-3 - EXISTING AND BASELINE ACCESS-MANAGEMENT PARAMETERS FOR THE UPPER WHITEFISH SUBUNIT*). In the present situation, grizzly bears benefited by the reduced

TABLE F-3 - EXISTING AND BASELINE ACCESS MANAGEMENT PARAMETERS FOR THE UPPER WHITEFISH SUBUNIT.

PARAMETER	CURRENT CONDITION	1996 BASELINE
POR density (percent exceeding 1 mile per square mile)	31.8	32.9
PTR density (percent exceeding 2 miles per square mile)	33.8	41.2
Potential security core area (percent greater than 500 meters from potential motorized disturbance)	51.6%	43.8%

FIGURE F-4—EXISTING ROADS AND ROAD MANGEMENT IN THE UPPER WHITEFISH GRIZZLY BEAR SUBUNIT

disturbance realized in the subunit. Managing motorized access reduces the potential for mortality, displacement from important habitats, and habituation to humans, and provides relatively secure habitat to reduce the energetic requirements (*Interagency Grizzly Bear Committee [IGBC] 1998*).

In addition to the timber harvesting proposed under this alternative, a native culvert restoration project is included. This project would require "walking" an excavator to the head of Stryker Basin to remove earthen fill from over numerous logs that were used to form a culvert for the existing road prism. DNRC hydrologist and fisheries biologists are concerned that these culverts will fail in the future and contribute high amounts of sediment to the West Fork of Swift Creek, which could affect bull and westslope cutthroat trout reproduction and survival (refer to *APPENDIX C—WATERSHED AND HYDROLOGY ANALYSIS* and *APPENDIX E—FISHERIES ANALYSIS*). Access to these culverts would require use of a road that is presently bermed and water-barred, making it relatively impassable to motorized vehicles.

Direct Effects

- ***Direct Effects of No-Action Alternative A to Grizzly Bears***

  No additional direct effects would occur under this alternative.

- ***Direct Effects to Grizzly Bears Common to Action Alternative B and C***

  Under these alternatives, disturbance would increase due to activities in the harvest areas and on the associated access roads. Due to the amount of area, Action Alternative B is expected to result in more direct negative effects than Action Alternative C. The specific road disturbance will be discussed under the cumulative effects analysis.

  To accomplish the harvests, some restricted roads would be used for commercial purposes, but public use would not be allowed over a period of several years. Disturbances associated with these roads are expected to result in decreased use of adjacent habitats by grizzly bears and will be discussed in the cumulative effects analysis.

Indirect Effects

- ***Indirect Effects of No-Action Alternative A to Grizzly Bears***

  No additional habitat would be altered. Hiding cover would be retained within the proposed harvest areas. In time, increases in canopy cover could reduce forage production. No additional disturbance due to road use would occur. Therefore, negligible effects are expected.

- ***Indirect Effects to Grizzly Bears Common to Action Alternatives B and C***

  Under Action Alternatives B and C, timber harvesting would reduce hiding cover. To assess the reduction in hiding cover, hiding cover is expected to be removed in all harvest areas where harvesting reduces overstory cover to 50 percent or less. Timber harvesting would reduce hiding cover in the project area by 1,270 acres under Action Alternative B and 938 acres under Action Alternative C. In both cases, visual screening would be retained along open roads (*ARM 36.11.432[1]*). The loss of hiding cover is expected to be short-term due to the rapid regeneration expected from the shrub component. Therefore, this alternative is expected to result in negligible, short-term

(5 to 10 years) negative effects to grizzly bears.

Following treatment, reduced canopy cover and burning could stimulate berry-producing plants and other forage items (*Marten 1979, Zager 1980*). However, mechanical scarification or a hot fire may reduce the response of berry-producing plants (*Zager 1980*). In areas with large patches of berry-producing plants, attempts would be made to avoid these patches or minimize damage to vegetative organs when mechanically scarifying the area. Increased forage would be approximately proportional to canopy removal. Therefore, forage increases are expected to be higher in Action Alternative B than under Action Alternative C. Additionally, Action Alternative B could increase reproduction of whitebark pine, a high energy autumn food source, by opening the forest canopy in Harvest Area III. The effects of both action alternatives would be positive and minor.

Cumulative Effects

- ***Cumulative Effects of No-Action Alternative A to Grizzly Bears***

  Under No-Action Alternative A, motorized access to the area would remain unchanged. In the short-term, hiding cover would be retained at the highest amount of any alternative. Forest succession would continue and could reduce food sources for grizzly bears, but increase the amount of hiding cover. Since hiding cover does not appear limiting in the subunit, maintaining this cover at the expense of food resources could reduce the quality of grizzly bear forage habitat in the subunit through time, resulting in negative minor effects.

- ***Cumulative Effects of Action Alternative B to Grizzly Bears***

  Under Action Alternative B, timber harvesting would not reduce hiding cover below 40 percent in any subunit. Since the subunit contains over 40 percent hiding cover, no measurable effects to grizzly bears are expected.

  Impacts to grizzly bears occur when the open-road density exceeds 1 mile per square mile because at this road density bears tend to avoid otherwise suitable habitat (*Mace et al. 1997*). Under this alternative, grizzly bears are expected to avoid an additional 1,368 acres of habitat due to the increased motorized use on roads associated with the timber harvests. Additionally, 1,052 acres of potential security would be lost (*FIGURE F-5 - EXISTING POTENTIAL SECURITY CORE AREAS AND THOSE AFFECTED UNDER EACH ALTERNATIVE IN THE UPPER WHITEFISH GRIZZLY BEAR SUBUNIT*). Additional losses to security core would occur due to the native culvert removal in Stryker Basin; however, this disturbance would occur for only about 1 week during the summer period when habitat is most abundant. The disturbance associated with the native culvert removal would be limited to a backhoe and a small crew that would remove culverts on Stryker Basin Road. This alternative would reduce the amount of habitat available to grizzly bears to less than was available in 1996 and exceeds *ARM 36.11.432(1)(c)* and *(d)*. During alternative development, this alternative received the approval by the Forest Management Bureau Chief (*ARM 36.11.432 [c][ii] and [d][i]*). The loss of habitat increases the energetic cost for grizzly

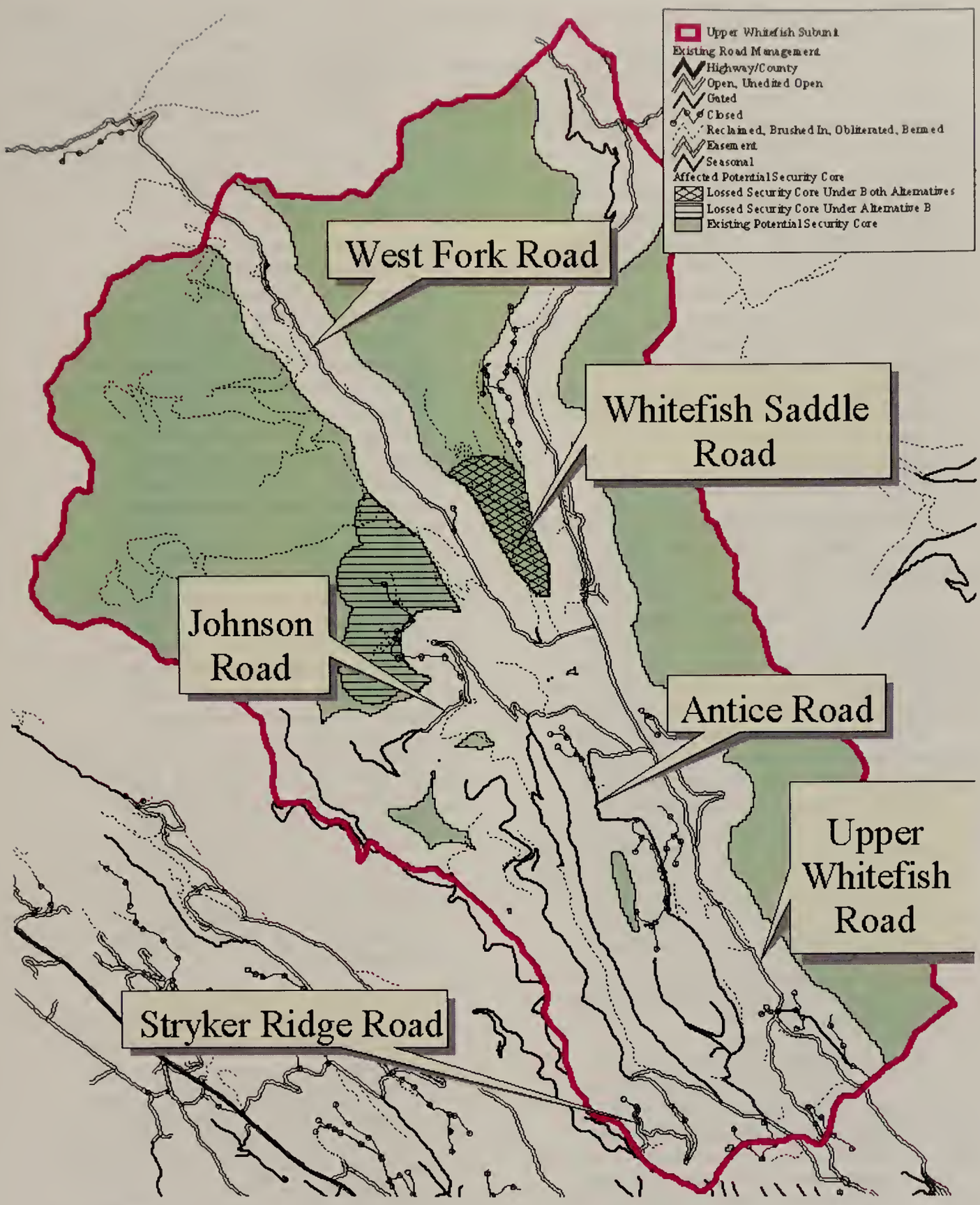


FIGURE F-5—EXISTING POTENTIAL SECURITY CORE AREAS AND THOSE AFFECTED UNDER EACH ALTERNATIVE IN THE UPPER WHITEFISH GRIZZLY BEAR SUBUNIT

bears using the area. In addition, increased access also increases the risk of mortality for bears. To mitigate this increased risk, any currently restricted road would retain the restriction to the general public. Additionally, contractors would not be allowed to carry firearms on restricted roads (*ARM 36.11.432[1][m]* referencing open-road density levels).

To mitigate the loss of grizzly bear habitat, several scenarios exist. The use of 3 road systems (Whitefish Saddle, North Johnson, and Twin Lakes roads) requires mitigation or an exception to *ARM 36.11.432(1)(c)(ii)*.

To mitigate the Whitefish Saddle Road, DNRC would move the existing gate on Johnson Road down to the base of the hill (Site A on *Alternative B Map* in *CHAPTER II*) to maintain road restrictions. Road restrictions would be maintained for the year (April 1 through November 15) that the Whitefish Saddle Road is used for more than 7 trips per week or 30 consecutive days. This scenario successfully mitigates the loss of habitat associated with the construction and use of Whitefish Saddle Road (*TABLE F-4 - THE EXISTING, PROPOSED, AND MITIGATED POR UNDER ACTION ALTERNATIVE B*).

There are several scenarios to mitigate for using the Johnson Road system:

⇒ Scenario 1 would require restriction of Stryker Ridge Road just past the intersection with Antice Road. This restriction would apply for the year(s) that the Johnson Road system was used for more than 7 trips per week or 30 consecutive days. If this were not acceptable,

⇒ Scenario 2 would extend the existing spring seasonal closure on the Antice Road to the full year for each year the Johnson Road system exceeds 7 trips per week or 30 consecutive days of motorized use.

With the Johnson closure mitigation included in the project design and implementation of 1 of the 2 scenarios, grizzly bears could be displaced from the project area; however, DNRC would reduce disturbance in other areas to offset the habitat affected by road use associated with the proposed timber harvests. If these mitigations were implemented, bears would be displaced from the specific habitats in the project area, but would have other habitats secured for them to 'displace into'. Therefore, with the abovementioned mitigations, the effects of this alternative are expected to be negligible.

Scenarios 1 and 2 both increase the amount of habitat affected as compared to the existing condition; however, both scenarios reduce the amount of habitat affected to less than the 1996 baseline (*TABLE F-4 - THE EXISTING, PROPOSED, AND MITIGATED POR UNDER ACTION ALTERNATIVE B*).

⇒ Scenario 3 would not incorporate road-disturbance mitigations while harvesting in Harvest Area III. The alternative practice authorized by the Forest Management Bureau Chief (*ARM 36.11.432[c]* and *36.11.449*) would be required for this scenario.

With the authorized alternative practice, the increased road disturbance

TABLE F-4 - THE EXISTING, PROPOSED, AND MITIGATED POR UNDER ACTION ALTERNATIVE B

1996 BASELINE	EXISTING CONDITION	ACTION ALTERNATIVE B WITHOUT MITIGATION	JOHNSON CLOSURE MITIGATION	HARVEST AREA III WITHOUT MITIGATION	HARVEST AREA III WITH STRYKER RIDGE CLOSURE MITIGATION	HARVEST AREA III WITH ANTICE CLOSURE MITIGATION
32.9%	31.8%	36.0%	32.7%	34.0%	31.5%	31.4%

could result in grizzly bears avoiding an additional 732 acres over the currently available habitat and 358 acres over the levels experienced during the 1996 baseline. The area where displacement of bears is expected provides good quality summer and autumn habitat. Displacement from these areas during the summer and autumn periods could result in increased energy expenditures and decreased forage consumption resulting in reductions of weight gain. Since bears are dependent on weight gain for survival and reproduction during the denning period, the displacement of bears from these good quality habitats could affect winter survival and reproduction. The scope of these effects is unknown and depends on a bear's ability to live in a disturbed area or seek out suitable undisturbed habitat. These effects would be present for at least the duration of the harvesting activities in Harvest Area III (approximately 3 nondenning seasons).

The combination of the timber harvesting proposed under Action Alternative B and the native culvert removal would reduce potential security core areas to less than the 1996 baseline, thereby violating *ARM 36.11.432(d)*. If this alternative is selected, approval by the Forest Management Bureau Chief would be required (*ARM 36.11.432 [d][i]*). Road access to Harvest Areas III would reduce security core areas by 1,052 acres, but still retain enough security core area to exceed the 1996 baseline. After 1996, Stryker Basin Road was bermed and water barred. This action increased the potential security core by approximately 2,500 acres. Therefore, while the timber sale in Harvest Area III is active, security core areas would be reduced, but would still be above the levels experienced in 1996. The combined use of North Johnson Road for timber harvesting and Stryker Basin Road for accessing the native culverts would result in a loss of security core area to less than 1996 levels. Options to restrict other roads in the subunit for long periods of time are extremely limited and not overly practical. Therefore, an exception to *ARM 36.11.432(d)* would be required for the native culvert removal. This project would occur between August 15 and September 15 and is expected to last approximately 1 week. The culvert removal is expected to prevent impacts to bull and native cutthroat trout (see *APPENDIX C—WATERSHED AND FISHERIES ANALYSIS* and *APPENDIX E—FISHERIES ANALYSIS*). The loss of security core area for 1 week during the late summer period is expected to be negligible. In addition, the culvert removal would further inhibit illegal motorized use. Following completion of this project, all

roads would revert to their existing management.

- ***Cumulative Effects of Action Alternative C to Grizzly Bears***

  Under Action Alternative C, timber harvesting would not reduce hiding cover below 40 percent in the subunit. Since the subunit estimates are well above 40 percent, no measurable effects to grizzly bears are expected.

  Impacts to grizzly bears could intensify when the open-road density exceeds 1 mile per square mile because at this road density bears tend to avoid otherwise suitable habitat (*Mace et al. 1997*). Under this alternative, grizzly bears are expected to avoid 556 acres of habitat due to the increased motorized use on roads associated with timber harvesting. To mitigate this increase, the gated closure on Johnson Road would be moved down to the base of the hill (Site A on Alternative C Map in *CHAPTER II*). This mitigation would reduce habitat avoidance to 309 acres over the existing condition. This increased amount of habitat disturbance is still less then those experienced during the 1996 baseline conditions. Additionally, 166 acres of potential security core area would be lost for the duration of the harvesting and postharvest activities in Harvest Area II-P (*TABLE F-5 - THE EXISTING, PROPOSED, AND MITIGATED POR UNDER ACTION ALTERNATIVE C*). Additional losses to security core would occur due to the repair of the native culvert in Stryker Basin. However, this disturbance would occur for only about 1 week during the summer period when habitat is most abundant. This disturbance would be limited to a backhoe and a small crew that would remove culverts on Stryker Basin Road. This alternative would not reduce the amount of habitat available to grizzly bears to less than was available in 1996 and does not exceed the limit of *ARM 36.11.432(1)(c) or (d)*. During implementation of the project, small losses of habitat could occur that increase the energetic cost for grizzly bears using the area. In addition, increased access also increases the risk of mortality for bears. To mitigate this increased risk, any currently restricted road would retain the restriction to the general public. Additionally, contractors would be restricted from carrying firearms on restricted roads (*ARM 36.11.432[1][m]*). Since these losses would affect a small area and be short term, this alternative is expected to have minor negative effects. Following completion of this project, all roads would revert to their existing management.

TABLE F-5 - THE EXISTING, PROPOSED, AND MITIGATED POR UNDER ACTION ALTERNATIVE C

1996 BASELINE	EXISTING CONDITION	ALTERNATIVE C	
		WITHOUT MOVING THE JOHNSON GATE	MOVING THE JOHNSON GATE
32.9%	31.8%	34.0%	32.7%

SENSITIVE SPECIES

When conducting forest-management activities, the SFLMP directs DNRC to give special consideration to the several "sensitive" species. These species are sensitive to human activities, have special habitat requirements that may be altered by timber management, or may become listed under the Federal Endangered Species Act if management activities result in continued adverse impacts. Because sensitive species usually have specific habitat requirements, consideration of their needs serves as a useful "fine filter" for ensuring that the primary goal of maintaining healthy and diverse forests is met. The following sensitive species were considered for analysis. As shown in *TABLE F-6 - LISTED SENSITIVE SPECIES FOR NWLO SHOWING THE STATUS OF THESE SENSITIVE SPECIES IN RELATION TO THIS PROJECT*, each sensitive species was either included in the following analysis or dropped from further analysis for various reasons.

TABLE F-6 - LISTED SENSITIVE SPECIES FOR NWLO SHOWING THE STATUS OF THESE SPECIES IN RELATION TO THIS PROJECT

SPECIES	DETERMINATION - BASIS
Black-backed woodpecker	No further analysis conducted - No burned habitat occurs in the project area.
Coeur d'Alene Salamander	No further analysis conducted - No moist talus or streamside talus habitat occurs in the project area.
Columbian sharp-tailed grouse	No further analysis conducted - No suitable grassland communities occur in the project area.
Common loon	No further analysis conducted - Neither alternative would occur near Upper Whitefish Lake.
Ferruginous hawk	No further analysis conducted - No suitable grassland communities occur in the project area.
Fisher	*Included* - Potential fisher habitat occurs in the project area.
Flammulated owl	No further analysis conducted - No dry ponderosa pine habitats occur in the project area.
Harlequin duck	No further analysis conducted - Neither alternative would occur near Swift Creek.
Mountain plover	No further analysis conducted - No suitable grassland communities occur in the project area.
Northern bog lemming	No further analysis conducted - No sphagnum bogs or other fen/moss mats occur in the area.
Pileated woodpecker	*Included* - Western larch/Douglas-fir and mixed conifer habitats occur in the area.
Townsend's big-eared bat	No further analysis conducted - No caves or mine tunnels occur in the project area.

➢ Fisher

Due to their use of mature and late-successional forested habitats, fishers are listed by DNRC as a sensitive species (*DNRC 1996*). DNRC's strategy to conserve fishers in a managed landscape is aimed at protecting valuable resting habitat near riparian areas and maintaining travel corridors.

Fishers are generalist predators and use a variety of successional stages, but are disproportionately found in stands with dense canopy (*Powell 1982, Johnson 1984*). Fishers appear to be highly selective of resting and denning sites. In the Rocky Mountains, fishers appear to prefer late-successional coniferous forests for resting sites and use riparian areas disproportionately to their availability. Fishers tend to use areas within 155 feet of water. Such areas contain large live trees, snags, and logs, which are used for resting and denning sites and dense canopy cover, which is important for snow intercept (*Jones 1991*). Field reconnaissance indicates that all of the proposed harvest areas provide fisher habitat. However, in some of the areas, large snags and downed wood are rare, while relatively abundant in other areas. Timber harvesting and associated road construction could affect fishers by altering habitat and/or increasing susceptibility to trapping.

Trapping pressure was responsible for the extirpation of fisher over most of their range by the 1930s. Although they again inhabit this area, populations remain vulnerable to trapping because fishers are easily caught in traps set for martens, bobcats, and coyotes; however, fishers are rare and are not trapped often. Vulnerability to trapping is influenced by the miles of road, both open and closed.

The Upper Whitefish Grizzly Bear Subunit was used to assess cumulative effects. For a description of the subunit and ownership, refer to the *Grizzly Bear* portion of this analysis. In the cumulative effects analysis area, State trust lands provide potential denning/resting, foraging, and travel habitat. Currently, these areas are highly connected, thereby allowing fishers to use and move relatively unimpeded through the project area and the subunit.

Direct Effects

- ***Direct Effects of No-Action Alternative A to Fishers***

  No additional human disturbance or increased vulnerability to trapping would occur.

- ***Direct Effects to Fishers Common to Action Alternative B and C***

  Under each action alternative, some displacement could occur; however, the effects of this displacement would be minor. The risk of displacement is approximately proportional to the amount of habitat affected; therefore, Action Alternative B (1,270 acres) poses more risk than does Action Alternative C (938 acres).

  Under Action Alternative B, 3.4 miles of new or temporary road would be constructed, while 3.1 miles of road would be constructed under Action Alternative C. The new temporary roads would increase access into the project area. Following use, these roads would be obliterated or restricted, thereby inhibiting use during the nonwinter period. However, during the winter period, access into the harvest areas via snowmobile would be increased. This increased access could

result in increased fisher mortality due to trapping. However, since fishers are rare and many of the areas are already accessible, no substantial changes to fisher vulnerability are expected.

Indirect Effects

- ***Indirect Effects of No-Action Alternative A to Fishers***

  Fisher habitat would remain relatively unchanged in the short-term. In the longer-term, more resting/denning habitat would develop. Fishers would benefit from the increased habitat and no increase in mortality risk, resulting in a potential increase in fisher use in the area.

- ***Indirect Effects of Action Alternative B to Fishers***

  Under Action Alternative B, 1,270 acres of habitat would be modified. In regeneration harvest areas (1,198 acres), harvesting would remove fisher habitat for a period of time (15 to 30 years) and reduce the habitat quality in the adjacent stands, because fishers avoid openings (*Roy 1991, Jones 1991*) and are rarely detected near abrupt-edge habitat adjacent to clearcuts (*Heinemeyer, unpublished*). The retention of seedtrees and snags would provide resting/denning structure for the future stand. However, these resources would be reduced by nearly 50 percent following harvesting. The regenerating areas could provide foraging habitat (snowshoe hare habitat) in the future (15 to 30 years). A 100-foot, no-harvest buffer along the West Fork and Stryker and Johnson creeks would be retained to protect potential high quality resting habitat and travel corridors, since fishers travel along stream courses and prefer habitats in proximity of water (*Jones 1991, Heinemeyer 1993*). This proposed alternative would reduce fisher habitat in the harvest areas; however, habitat and travel corridors along perennial streams would be retained to provide fisher resting/denning habitat and allow movement through the project area. Within each harvest area, snags and large trees would be retained to provide denning/resting sites in the future. This would reduce the amount of time needed to become fisher habitat from 100+ years to develop resting structure to 15 to 30 years needed to develop horizontal cover. The reduction of denning/resting sites and foraging habitat in the uplands would result in increased energy expenditures, while decreasing forage opportunities. This alternative is expected to remove fisher habitat, while retaining travel corridors along stream courses, resulting in minor negative effects to fishers.

- ***Indirect Effects of Action Alternative C to Fishers***

  Under Action Alternative C, the same effects discussed above are expected; however, this alternative would not harvest in Harvest Area III (332 acres). Harvest Area III has less desirable fisher habitat than the other areas in the flatter topography; therefore, this alternative would result in slightly less minor effects to fisher.

Cumulative Effects

- ***Cumulative Effects of All Alternatives to Fishers***

  Salvage operations and firewood cutting on State trust lands has decreased habitat. Salvage and regeneration harvests, especially in mature and late

successional stands, has reduced the amount of habitat available on State trust lands. Habitat conditions on USFS lands are expected to improve in time; however, these lands occur higher in the drainage and are probably used less by fishers than the lower elevations. Under all alternatives, movement corridors from the project area into the cumulative effects area would be retained. The effects of the new roads discussed above would also apply to the cumulative effects area. Overall, Action Alternative B would combine with other activities on DNRC-managed to produce minor negative effects to fishers. Slightly less minor effects are expected under Action Alternative C.

- **Pileated Woodpecker**

  Pileated woodpeckers, listed by DNRC as sensitive, play an important ecological role by excavating cavities that are used in subsequent years by many other species of birds and mammals.

  Pileated woodpeckers excavate the largest cavities of any woodpecker. Preferred nest trees are western larch, ponderosa pine, cottonwood, and quaking aspen, usually 20 inches dbh and larger. Pileated woodpeckers primarily eat carpenter ants, which inhabit large downed logs, stumps, and snags. *Aney and McClelland (1985)* described pileated nesting habitat as "stands of 50 to 100 contiguous acres, generally below 5,000 feet in elevation with basal areas of 100 to 125 square feet per acre and a relatively closed canopy." The feeding and nesting habitat requirements, including large snags or decayed trees for nesting and downed wood for feeding, closely tie these woodpeckers to mature forests with late-successional characteristics. The density of pileated woodpeckers is positively correlated with the amount of dead and/or dying wood in a stand (*McClelland 1979*).

  Potential pileated woodpecker nesting habitat was identified by searching the SLI database for 'old stands' with more than 100 square feet basal area per acre, more than 40 percent canopy cover, and below 5,000 feet in elevation. Due to the relatively high elevation of the project area, the pileated woodpecker is limited to the drainage bottoms in the project area. Only Harvest Area II (except Subarea II-H) provides pileated woodpecker habitat. Harvest Areas I and III are above 5,000 feet in elevation and are unlikely to be used often or heavily. Older aged stands with dense amounts of dead wood would provide pileated with nesting habitat, younger aged stands could provide feeding or lower quality nesting habitats. Since even the subareas in Harvest Area II are at the upper extremes used by pileated woodpeckers, this habitat is probably marginal.

  The project area is large and the analysis conducted for the project area encompassed enough area to support several pairs of pileated woodpeckers; therefore, the cumulative effects analysis area is the project area.

Direct Effects

- ***Direct Effects of No-Action Alternative A to Pileated Woodpeckers***

  No disturbance of pileated woodpeckers would occur.

- ***Direct Effects to Pileated Woodpeckers Common to Action Alternatives B and C***

  Under the action alternatives, pileated woodpeckers could be affected if harvesting occurred during the nesting period. Nesting woodpeckers could be displaced by the harvesting activities. The effects of harvesting disturbance are unknown; however, *Bull et al. (1995)* observed a discernible woodpecker roosting near a harvest area consistently throughout harvesting. Additionally, mortality of individual woodpeckers could occur if nest trees were inadvertently cut. This risk would be low because most nest trees possess some rot; therefore, they have low merchantability and would likely not be harvested. Action Alternative B would result in a low risk of directly affecting pileated woodpeckers. Action Alternative C would result in slightly less risk of directly affecting pileated woodpeckers than Action Alternative B.

Indirect Effects

- ***Indirect Effects of No-Action Alternative A to Pileated Woodpeckers***

  The existing trees would continue to grow and die, thus providing potential nesting and foraging substrate for pileated woodpeckers. However, as these trees die, barring any disturbance, replacement trees (shade-intolerant) would not be present. Therefore, under this alternative, pileated woodpecker habitat would increase through time, then decline, resulting in a short- to mid-term moderate beneficial effect to pileated woodpeckers, but a long-term minor negative effect.

- ***Indirect Effects to Pileated Woodpeckers Common to Action Alternatives B and C***

  Under Action Alternatives B and C, 775 acres of pileated woodpecker habitat in the project would be modified. All of these areas would experience a regeneration harvest, thereby reducing the quality of nesting habitat for a long period of time in all proposed harvest areas (*McClelland 1979*). Some of the dominant and clumps of trees would be retained and would be expected to increase growth rates due to reduced competition. Additionally, large snags would be targeted for retention, especially western larch snags greater than 21 inches dbh, thereby retaining some feeding and nesting structures in the harvest area. However, some snags could be lost due to harvesting. These snags would be left on site to provide feeding substrates for pileated woodpeckers and other wildlife species. These alternatives are expected to result in negligible negative effects to pileated woodpeckers. In the longer term, seral species would be planted under this alternative and could provide pileated woodpecker habitat in the distant future.

Cumulative Effects

- ***Cumulative Effects of No-Action Alternative A to Pileated Woodpeckers***

  Pileated woodpecker habitat in and around the project area would increase through time on DNRC lands, then decline. This alternative would result in continued retention of the existing pileated woodpecker habitat on DNRC lands. These conditions would result in

continued retention of pileated woodpecker habitat.

- ***Cumulative Effects to Pileated Woodpeckers Common to Action Alternatives B and C***

  Under Action Alternatives B and C, potential habitat would be reduced; this loss would be additive to past harvesting and salvaging on DNRC lands. Under both action alternatives, pileated woodpecker habitat in the analysis area would be reduced by 775 acres. The reduction is expected to cumulatively contribute to reduced habitat quality and quantity in the analysis area. However, since the analysis area occurs in higher elevation and, presumably, lower habitat quality, any effects would be negligible. The long-term minor benefit could be realized by the regeneration of shade-intolerant tree species that are important nesting structures.

BIG GAME SPECIES

Deer, elk, and moose inhabit the project area. However, due to heavy snow accumulations and high elevation, big game use of the project area is restricted to the nonwinter period. During the nonwinter period, forage and hiding cover are important components for these species. The project area provides dense hiding cover in both harvested and unharvested stands. To assess cumulative effects, the Upper Whitefish Grizzly Bear Subunit was considered.

DIRECT EFFECTS

- ***Direct Effects of No-Action Alternative A to Big Game Species***

  No additional human disturbance or increased vulnerability to hunting would occur.

- ***Effects of Action Alternative B and C to Big Game Species***

  Under each action alternative, some displacement could occur; however, the effects of this displacement would be minor. The risk of displacement is approximately proportional to the amount of habitat affected; therefore, Action Alternative B (1,270 acres) poses more risk than does Action Alternative C (938 acres). Any use of restricted roads during the project period would require the contractor to keep the road restricted to the public with a sign while active and with a locked gate during inactive periods (nights, weekends, breakdowns, etc.). This mitigation measure would result in no increased direct effects to big game species.

INDIRECT EFFECTS

- ***Indirect Effects of the No Action Alternative A to Big Game Species***

  No changes to big game habitat would occur in the short-term. In the longer-term, forage items could be reduced as canopy cover

increases. These changes would be slow and localized. Hiding cover is not expected to change dramatically over time. This alternative is expected to result in negligible effects.

- ***Indirect Effects of Action Alternative B and C to Big Game Species***

  Removal of the overstory canopy closure is expected to increase forage items, but would also reduce hiding cover. The reduction in hiding cover is expected to be short-term due to the rapid regrowth of shrubs in the project area. Visual screening would be retained along open roads in the project area. Since Action Alternative B would affect more area than Action Alternative C, these effects would be more pronounced in the project area under Action Alternative B. However, these effects are expected to be negligible and could result in slight habitat shifts.

CUMULATIVE EFFECTS

- ***Cumulative Effects of All Alternatives to Big Game Species***

  Under all alternatives, vegetative cover, especially along streams, would allow movement into and out of the project area. Harvest areas are expected to increase forage production in the cumulative effects area, with Action Alternatives B expected to produce more forage than Action Alternative C. No increases in forage production are expected due to No-Action Alternative A. Since no other projects are planned in the cumulative effects area, the effects discussed for the project area also hold true for the cumulative effects area.

APPENDIX G
ECONOMIC ANALYSIS

INTRODUCTION

The West Fork Timber Sale Project is located in Stillwater State Forest, north of Whitefish in Flathead County. The project is in an area of relatively low population density and has produced timber for the area mills since the early 1900s. The focus of the economic section will be on market activities that directly or indirectly benefit the Montana education system, generate revenue for the school trust funds, and provide funding for public buildings.

Flathead and Lincoln counties have historically provided both manufacturing and recreational pursuits. Manufacturing has historically focused on mining and timber, as well as a limited amount of agriculture processing. Recreation has focused on Glacier National Park, as well as the many lakes and mountains in the region. Mining has declined within the area in recent years, while timber has remained comparatively steady or declined slightly.

EXISTING CONDITIONS

The location of Stillwater State Forest in relation to purchasers likely to be interested in timber sales necessitates analyzing economic and demographic data for both Flathead and Lincoln counties, although there is a potential for purchasers further south and west to be interested in this sale. *TABLE G-1 - SELECTED DEMOGRAPHIC INFORMATION FOR FLATHEAD AND LINCOLN COUNTIES* contains selected demographic information for each of these counties and for the entire State.

Flathead County is known for its production of "Flathead cherries". Flathead County also has a large wood-products sector producing a variety of products that include dimensional lumber, plywood, and molding. In addition to wood products, Flathead County also has a large recreation industry that includes the primary entrance to Glacier National Park and Big Mountain, a large and major ski destination.

TABLE G-1 - SELECTED DEMOGRAPHIC INFORMATION FOR FLATHEAD AND LINCOLN COUNTIES

Demographic	Flathead	Lincoln	Montana
Population 1990	59,218	17,481	799,065
Population 2000	74,471	18,837	902,195
Growth Rate	2.4%	0.8%	1.2%
Median Age	37.2	38.2	37.8
School Enrollment	13,000	3,012	157,560

Lincoln County is located in the northwest corner of Montana. Historically, both mining and wood manufacturing played a large role in the County's economic activities. In recent years, mining has declined in the region and the timber industry has remained as one of the primary employers. An abundance of forests, lakes/streams, and wildlife have made the area also heavily used by recreationalists.

School enrollment for kindergarten through grade 12 in the 2 counties combined is over 16,000.

The data in *TABLE G-2 - COVERED WAGES AND EMPLOYMENT IN 2002 FOR SELECTED INDUSTRIES IN FLATHEAD AND LINCOLN COUNTIES* shows employment and income in selected industry categories for each of the 2 counties that are included in the analysis. Economic activity within

TABLE G-2 - COVERED WAGES AND EMPLOYMENT IN 2002 FOR SELECTED INDUSTRIES IN FLATHEAD AND LINCOLN COUNTIES

INDUSTRY	FLATHEAD COUNTY			LINCOLN COUNTY		
	AVERAGE ANNUAL EMPLOYMENT	ANNUAL WAGES (000)	AVERAGE WAGE	AVERAGE ANNUAL EMPLOYMENT	ANNUAL WAGES (000)	AVERAGE WAGE
Agriculture, forestry, and fishing	424	$13,717	$32,340	236	$6,655	$28,201
Forestry	70	10,392	36,898	210	5,893	28,020
Construction	2,411	73,054	30,295	193	5,190	26,928
Manufacturing	3,264	122,266	37,461	664	21,082	31,755
Lumber	1,426	55,536	38,945	575	19,190	33,384
Metals	475	21,280	44,800	NA	NA	NA
Transportation	659	18,072	27,410	127	2,554	20,180
Trade	5,776	124,546	21,563	640	10,144	15,850
Eating and drinking establishments	2,685	29,392	10,259	363	2,969	8,178
Finance, insurance, and real estate	1,797	57,826	32,180	163	7,388	19,907
Services	9,736	290,648	19,875	1,554	24,177	15,557
Hotels, etc.	1,254	18,908	15,074	99	1,101	11,109
Amusement and recreation	952	12,667	13,306	81	985	12,221
Government	4,389	136,196	31,035	1,393	42,552	30,542
Total all industries	33,446	$853,132	$25,508	5,085	$118,983	$23,399

the 2 counties varies substantially, although both counties have timber-related industry present. Lincoln County is less populated and less developed than Flathead County.

Lincoln County has a substantially smaller labor force and the smallest number of workers employed in timber-related jobs. The average wage in the timber industry is 53 percent higher than the overall average wage in Flathead County (38,945 divided by 25,508 times 100) and 43 percent higher than the overall average wage in Lincoln County (33,384 divided by 23,399 times 100). Service industry wages are lower than the overall average wage in both counties. The service industries provide employment for over twice as many workers as the timber industry in Lincoln County and nearly 9 times as many workers as the timber industry in Flathead County. The average wage in the service industry is almost one-half of the average wage in the timber industry in both counties.

ALTERNATIVE EFFECTS

DIRECT EFFECTS

Three options are being analyzed in this Environmental Impact Statement: No-Action Alternative A; Action Alternative B, which includes harvesting an estimated 61,750 tons (9.5 MMBF) of timber; and Action Alternative C, which includes harvesting an estimated 37,115 tons (5.7 MMBF) of timber. The following estimates are intended for relative comparison of alternatives and not intended to be absolute estimates of returns, taxes, employment, or wages.

- ***Direct Effects of No-Action Alternative A***

  None of the employment, income, or trust fund effects that result from the action alternatives would occur.

- ***Direct Effects of Action Alternatives B and C***

Timber Sale Effects

TABLE G-3 - ESTIMATED REVENUES AND EXPENDITURES FROM THE WEST FORK OF SWIFT CREEK TIMBER SALE PROJECT **displays** the estimated revenue and expenditures associated with the West Fork Timber Sale Project. The 2 alternatives analyzed may, for administrative purposes, be broken into smaller sales, but are treated as a unit for the purpose of this analysis. The volume for Action Alternative B is 61,750 tons, or 9.5 MMBF. The corresponding volume associated with Action Alternative C is 37,115 tons, or 5.7 MMBF. The areas associated with each alternative are identified in the map section of Chapter II.

Broader market and local stumpage prices are currently well above the long-term average. These prices are highly dependent on the housing market and foreign timber imports. The housing market is highly dependent on the interest rate, which, in part, determines who can "qualify" to purchase a home. Interest rates are currently at very low levels; these low levels have not been seen since the late 1950s and early 1960s. Low interest rates normally impact the housing market by stimulating new construction to satisfy the demand for housing from individuals who can now "qualify" to purchase a home. The growth of the economy appears to be increasing, as the economic effects of the bombing of the World Trade Center on September 11, 2001 continues to decline. The result of the growth and low interest rates has been a continued strong housing market. Mortgage interest rates appear to be remaining at low levels, which helps keep the demand for housing strong.

Restricted imports of timber and sheet goods from other countries, primarily Canada, have helped bolster prices by reducing the supply of timber available to homebuilders. In addition, the demand for U.S. timber has increase due to a combination of economic recovery in several countries and the devaluation of the U.S. dollar, which makes our timber relatively cheaper to foreign buyers. The timber prices used in this analysis attempt to recognize the current market conditions.

Underlying Assumptions

Project impact estimation and analysis assumes that most of the economic impact associated with the sales would take place in the 2-county area. The estimates are intended for comparative purposes and do not purport to be the value of the impacts in any absolute sense. Stumpage prices were determined using the current transaction equation modified by professional judgment to reflect current and local market conditions as much as possible.

The FI fee is for a program to provide funding for forest development and improvement and is collected from the logging company as part of their bid. Activities funded

TABLE G-3 - ESTIMATED REVENUES AND EXPENDITURES FROM THE WEST FORK OF SWIFT CREEK TIMBER SALE PROJECT

	ACTION ALTERNATIVE B	ACTION ALTERNATIVE C
Harvest volume	61,750 tons	37,115 tons
Stumpage price $/ton	$26.55	$25.50
Forest improvement fee	$631,750	$379,700
Stumpage revenue	$1,639,100	$947,600
Trust income	$677,900	$359,000
State income	$2,270,850	$1,327,300
Expenditures	$961,200	$588,600

Source: DNRC, Trust Land Management.
**The State does not identify expenses for individual timber sales. The estimates used here are based on area-wide averages.*

under this program include site preparation, tree planting, thinning, roadwork, right-of-way acquisition, etc. The current FI fee for the NWLO area is $66.50 per MBF.

TABLE G-4 - NUMBER OF STUDENTS SUPPORTED BY 1 YEAR OF ESTIMATED REVENUE shows the difference in revenue to the trusts from the 2 action alternatives.

TABLE G-4 - NUMBER OF STUDENTS SUPPORTED BY 1 YEAR OF ESTIMATED REVENUE

	ACTION ALTERNATIVE	
	B	C
Estimated school revenue	$677,900	$359,000
Students supported*	96	51

Source: Montana Department of Natural Resources and Conservation, Trust Land Management
**Assumes all of the "trust" income would be distributed for educational purposes. Depending on the trust, some of the income is distributed to a fund that earns revenue for future education funding.*

The school trust income from a timber sale under Action Alternative B is estimated to be $677,900; enough to fund the education of 96 students for 1 year based on an average cost of $7,080, as determined by information provided by the Montana Office of Public Instruction. This information is shown in *TABLE G-4 - NUMBER OF STUDENTS SUPPORTED BY 1 YEAR OF ESTIMATED REVENUE*. If the sale does not take place, no students are benefited. A "cost" of not harvesting, compared to harvesting the timber under Action Alternative B, is the loss of financing for 96 kindergarten through grade 12 students for 1 year.

The school trust income from a timber sale under Action Alternative C is estimated to be $359,000; enough to fund the education of 51 students for 1 year based on an average cost of $7,080, as determined from information provided by the Montana Office of Public Instruction. This information is shown in *TABLE G-4 - NUMBER OF STUDENTS SUPPORTED BY 1 YEAR OF ESTIMATED REVENUE*. If the sale does not take place, no students are benefited. Thus, one of the "costs" of not harvesting the timber, compared to harvesting under Action Alternative C, is the loss of financing for 51 kindergarten through grade 12 students for 1 year.

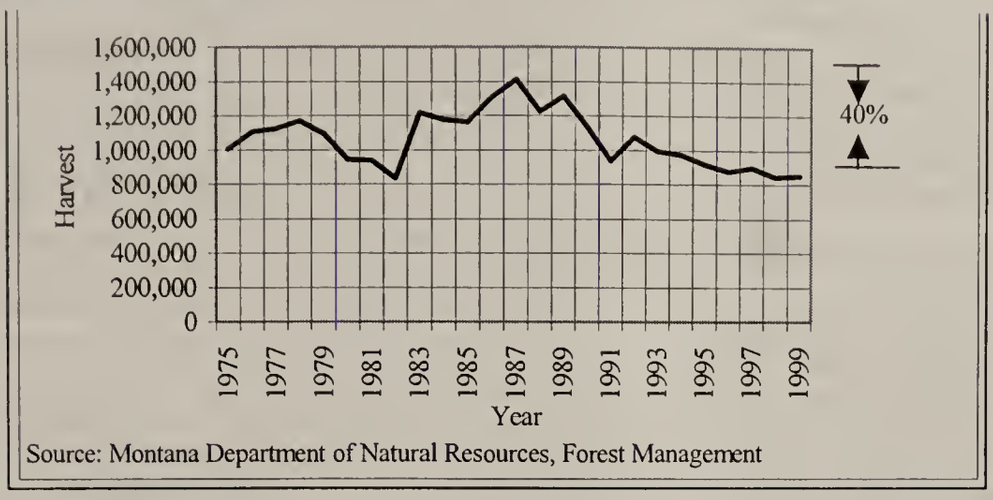
If the trust does not fund these students through the sale of timber, funding must come from other sources, primarily property taxes.

Timber-Related Employment

Timber harvesting generates employment. *Keegan et al* estimate that on average 10.58 jobs are created or maintained for every MMBF of timber harvested. Both economic theory and empirical analysis suggest that the marginal effect of an increase in the timber harvested is likely to be different than the average effect because of increasing returns. The marginal effect may be larger or smaller than the average. Empirical evidence would suggest that in a growing industry marginal effect on employment is likely to be smaller than the average. In a contracting industry, the marginal effect on employment could be either larger or smaller than the average. In most cases the marginal effect of increased or decreased timber sales is "lumpy", i.e. 2 sales of the same size under different conditions might induce a larger-than-average employment response in one case and a smaller-than-average, or nearly negligible, employment response in another.

FIGURE G-1 - TOTAL TIMBER HARVESTED FROM MONTANA FORESTS (MBF) demonstrates that the amount of timber being harvested in Montana from all sources has declined since 1987. The decrease in harvesting since the peak of 1,411 mmbf in 1987 has been nearly 40 percent to 854 mmbf in 1999. Mills, such as the Louisiana-Pacific Mill in Belgrade,

FIGURE G-1 - TOTAL TIMBER HARVESTED FROM MONTANA FORESTS (MBF)



Source: Montana Department of Natural Resources, Forest Management

recently closed, citing a lack of available timber as part of the cause of their closure. All of these point to an industry declining in size. Based on the previous discussion, the assumption of the average induced employment of 10.58 jobs per mmbf is reasonable. Because the exact conditions of this sale are unknown, the best estimate of employment, (i.e., the average effect on employment) should be used since it is the best estimate available and the marginal effect of the sale is unknown.

A ratio of 10.58 jobs per mmbf of wood harvested implies the direct generation of between 60 and 100 jobs and between $2.2 and $3.7 million in wages for each alternative as shown in *TABLE G-5 - WEST FORK I TIMBER SALE DIRECT EMPLOYMENT AND INCME IMPACTS*. The wages are based on an average wage of $37,347 for lumber industry in both counties, using the from data in *TABLE G-1—SELECTED DEMOGRAPHIC INFORMATION FOR FLATHEAD AND LINCOLN COUNTIES*. These are the wages that directly result from the timber harvest. Without a timber harvest, income would be lost to the State and communities. Wages in the timber industry are higher than average. This allows individuals working in the industry to obtain higher than average ownership of real personal property. Since much of the revenue for school funding comes from property taxation, higher levels of real property ownership should provide for better school funding.

In addition to these jobs, additional employment is created when the income earned within the timber industry is spent to purchase goods and services elsewhere in the economy. There are also impacts from the logging companies and timber mills when they purchase goods and services from the local economy. Both of these effects are important since they support other community businesses such as grocery and clothing stores, gas stations, etc. The loss of the income from this sale would mean not only the loss of the direct income, but the loss of the indirect income as well.

The economic impact on the schools occurs through ways other than just the direct contribution to the school trust fund from the revenue generated through timber sales. The timber industry pays taxes on the facilities it owns and operates. In the year 2000, the timber industry paid estimated taxes of over $848,600 to the schools in Flathead and Lincoln counties. The tax contribution, however, may decline in the future if more mills, such as American Timber Company in Flathead

TABLE G-5 - WEST FORK TIMBER SALE DIRECT EMPLOYMENT AND IMCOME IMPACTS

	ACTION ALTERNATIVE B	ACTION ALTERNATIVE C
Direct employment	100	60
Wages and salaries	$3,734,700	$2,240,800

County, close. The closure of this mill has reduced the tax base by an estimated $4.4 million (*Jackson, South Wood Timber Sale EIS*), thereby reducing the taxes received by the school districts by about $28,500. This is a permanent reduction in school funding for over 4 students per year.

INDIRECT EFFECTS

Indirect economic impacts are much broader than those identified above. Some of these impacts are the result of the money from the timber sales "recycling" through the economy several times. For example, the money spent for groceries by the employee of the timber mill, in part, goes to pay the salary of the grocery store employees; the grocery store employees use that money to purchase groceries for themselves. This, in turn, generates more income for the grocery store employees, etc. Unfortunately, a model of the county that could be used to demonstrate secondary effects is not available. In a broader State-wide context, money paid to the woods industry workers results in increased State income tax collections as well as increased purchases in other areas of the State. Income tax collections from the wages of millworkers alone are estimated to generate between $87,000 and $146,000 in State tax revenue, depending on which alternative is selected. Taxes on indirect wages would add to this tax amount. Since State revenue is spent on projects State-wide, the entire State shares, in part, in the benefits that result from the timber sale. In particular, Montana schools benefit additionally by being able to use these revenues to fund schools throughout the State.

Nonmarket Issues

A quantitative analysis of the economic value of nonmarket benefits and costs will not be part of this analysis because they do not generate income for the trust, although they do affect the well-being of Montana residents. Because of their effects, a short qualitative discussion of nonmarket issues follows.

A brief description of the biological impacts is included in order to identify areas where economic values might be affected. A more detailed discussion of the biological impacts is found in other sections of the report.

Environmental Modifications - The harvest of the timber would modify the undisturbed development of the forest and, as a result, would affect both the short- and long-term habitat and wildlife regimes. How individuals value these modifications is an empirical question and may be viewed either positively or negatively by different individuals. The estimation of the net social benefit or loss of the impacts described in this EIS is an empirical issue that does not directly affect the school trust fund.

Human Use - The harvest area has been historically used for recreational purposes such as hiking, hunting, and fishing. While the use of these areas is likely to decline or change during the period of logging, long-term overall use of the area is expected to remain high. Some nonmarket uses are unlikely to change. Fishing, for example, should not be severely affected by the logging since SMZ laws protect streams. The aesthetics would be modified; some individuals would view this as a loss, others may prefer the more-open forest that would result from the harvest. Visual changes are minimized to the extent practicable by limiting the trees harvested in some areas and by "sculpting cuts" to avoid "unnatural" visual lines. Some activities may be enhanced. For instance, the logged area may enhance the habitat of some game species, and the increased use of

areas by those game species may make the area more attractive to hunters. As in the case of the environmental modifications, the net social benefit or loss is an empirical issue dependent on individual values.

Social Impacts

The area has a substantial presence in the wood-processing industry and, as a result, has institutions established to handle the social requirements associated with this industry. This timber sale is unlikely to add sufficient pressures to these institutions to require their modification. A high rate of employment (low rate of unemployment) is associated with lower rates of crime, domestic violence, alcohol/drug problems, and a healthier, more satisfied community. To the extent that No-Action Alternative A might contribute to unemployment, the social impact of the harvest might be a short-term negative social impact on the community. Conversely, to the extent that the sale provides employment, the short-term impact would be positive.

Roads and Infrastructure

New roads are to be constructed for the sale(s). Existing roads would be improved to handle the logging truck traffic and provide transport for other equipment used in logging. Expenditures for road improvements are identified in both action alternatives as part of the sale development cost. Some improvements are also funded through FI funds, as well as other funds set up for this purpose. To the extent that these expenditures are spent locally, they will improve local economic conditions. A portion of the money will leave the area and provide income for other areas of the State and national economies. The culverts, for example, usually come from manufacturers outside of Montana; however, most of the road improvement expenditures will remain in Montana.

Population Impacts

Logging and milling activities associated with the timber sale are not anticipated to have any long-term impact on the population of the region or the State of Montana.

CUMULATIVE EFFECTS

This sale would be part of the annual harvest of timber from the State of Montana forest trust lands. The net revenue from this sale would add to the trust fund. Annual trust fund contributions have varied widely over the years, because the actual contribution to the trust is more a function of harvest levels than of sales. Harvest levels can vary substantially over time; sales tend to be more consistent. *TABLE G-6 - ANNUAL REVENUE FROM TIMBER HARVESTED FROM MONTANA TRUST LANDS* shows the annual revenue from harvesting for the last 5 years. The net contribution to the trust fund is also affected by the annual costs experienced by the Department for program management, which varies year to year. The Department should continue to make net annual contributions to the trust from its forest management program.

TABLE G-6 - ANNUAL REVENUE FROM TIMBER HARVESTED FROM MONTANA TRUST LANDS

YEAR	HARVEST REVENUE ($)
2003	8,270,589
2002	9,699,034
2001	8,524,150
2000	12,710,311
1999	6,998,847

DNRC has a State-wide sustained-yield annual harvest goal of 50 MMBF. If timber from this project is not sold, this volume could come from sales elsewhere; however, the timber may be from other areas and not benefit this region of the State. A long-term deferral of harvesting from this forest would

impact harvest patterns, changing both the region where the trees are harvested and the volumes taken. This would impact other areas of the State where these changes occur.

ACRONYMS

ARM	Administrative Rules of Montana
BMP	Best Management Practices
cmp	corrugated metal pipe
CS	Common Schools (trust)
dbh	diameter at breast height
DEQ	Department of Environmental Quality
DFWP	Department of Fish, Wildlife and Parks
DNRC	Department of Natural Resources and Conservation
DEIS	Draft Environmental Impact Statement
EA	Environmental Assessment
ECA	Equivalent Clearcut Acres
EIS	Environmental Impact Statement
EPA	Environmental Protection Act
FEIS	Final Environmental Impact Statement
FI	Forest Improvement
FNF	Flathead National Forest
IGBC	Interagency Grizzly Bear Committee
mbf	thousand board feet
MCA	Montana Codes Annotated
MEPA	Montana Environmental Protection Agency
mmbf	million board feet
MNHP	Montana Natural Heritage Program
NCDE	Northern Continental Divide Ecosystem
NWLO	Northwestern Land Office
RMZ	Riparian Management Zone
SFLMP	State Forest Land Management Plan
SLI	Stand Level Inventory
SMZ	Streamside Management Zone
TLMS	Trust Land Management System
TMDL	Total Maximum Daily Load
USFS	United States Forest Service
USFWS	United States Fish and Wildlife Service

ID Team	Interdisciplinary Team
Land Board	Montana Board of Land Commissioners
124 Permit	Stream protection Act Permit
3A Permit	Authorization A – Short-term Exemption from Montana's Surface Water-Quality Standards
SFLM Rules	State Forest Land Management Rules

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